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1960 No. 2

Seals and Scottish Fisheries

By BENNET B. RAE, M.A., B.Sc., Ph.D.

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The functions of the Scottish Home Department relating to Fisheries were transferred on 1st April, 1960 to the Department Agriculture for Scotland, which will in future be known as the Department of Agriculture and Fisheries for Scotlan

Seals and Scottish Fisheries

INTRODUCTION

The nature and extent of the damage caused by seals to fisheries, particularly salmon fisheries, has been debated for many years. While salmon fishermen, on the one hand, continue to press their grievances, seal lovers, on the other, steadfastly reject these claims and insist with even greater vigour on the need for conservation of at least one species, the grey seal. During recent years attention has been focused even more sharply on this problem by reports of increases in the seal population round the British coasts and by the ever-widening field of complaint from salmon fishermen, especially from those operating on Scottish coasts. The views of the two parties are so contradictory that an examination of the evidence on each side appears to be long overdue.

In the preparation of this paper a variety of material has been examined or consulted, including works on natural history, scientific papers, files of the Fishery Board for Scotland up to 1939 and of the Scottish Home Department from that year onwards, reports and logs by salmon fishermen, articles and letters in newspapers and trade journals and Parliamentary speeches as reported in Hansard. Many salmon netsmen and fishermen were interviewed and questioned during 1958 and 1959. Fishing stations were visited, nets examined and mutilated salmon inspected and photographed. Enquiries have been made of marine fishermen, of white-fish merchants and of fishery officers. Seal carcases received at the Marine Laboratory, Aberdeen, were identified and dissected for their stomach contents and parasites. Numerous letters were exchanged with naturalists and scientists both at home and abroad.

The writer wishes to thank netsmen and fishermen, who have contributed information and specimens, and to express his special appreciation of the generosity of Messrs. Joseph Johnston & Sons Ltd. of Montrose. Thanks are also due to colleagues on the freshwater and marine staffs for assistance in interviewing netsmen and in dissecting seals, and in particular to Mr. H. McCall, librarian, and his staff, for procuring so many papers and volumes from external sources.

THE GREY SEALS PROTECTION ACTS AND EVENTS LEADING UP TO THEM

The historical notes briefly reviewed here are amplified in the Appendix (page 33). The first Grey Seals Protection Act was passed in 1914, and provided for a close season extending from 1st October to 15th December. To the scientist, the evidence on which this Act was passed, including the belief that the grey seals stocks round the British Isles had been reduced by slaughter to as few as 500 is, as far as it is available today, tenuous indeed. Subsequently, naturalists as experienced as the late Professor James Ritchie and Mr. W. L. Calderwood could find no evidence for that belief. Their own investigation, made in 1927, indicated a population of between 4,000 and 5,000 with about 1,000 pups being born each year, so that they had no hesitation in considering any danger of extinction to have passed.

Meanwhile, the time-limited Act of 1914 was being renewed from year to year, and in 1932 another Act was passed in which the original close time was increased to extend from 1st September to 31st December. This was not passed without opposition, for complaints by fishermen about damage to nets were increasing, but opposition was withdrawn when the Bill was adjusted to give the Secretary of State for Scotland and the Minister of Agriculture and Fisheries power to cancel the close time, either generally or with respect to particular areas.

In the years following the second Great War salmon fishermen reported a marked increase in the number of grey seals in Scottish waters. This was particularly noticeable in the vicinity of Berwick-on-Tweed and was attributed to the growth of the colony on the Farne Islands under the protection afforded by the Act of 1932 and by the taking over of the Islands by the National Trust. About this time Dr. Fraser Darling in a report to the Scottish Committee of the Nature Conservancy drew attention to the

greatly increased grey seal stocks and anticipated pressure from 'fishing interests' to have the numbers reduced. Darling (1952) also investigated the damage to salmon fisheries in the Tweed, on behalf of the Tweed Commissioners, and reported that this was undoubtedly due to the increased numbers of grey seals on the Farne Islands. At the end of 1955, following representations by the River Tweed Commissioners, the Member of Parliament for Berwick and East Lothian asked the Minister of Agriculture and Fisheries if he would consider steps to keep the seal population of the Farnes 'within reasonable limits'. In reply it was pointed out that the matter was now being investigated by the Nature Conservancy.

In April 1957 the Salmon Net Fishing Association of Scotland presented a Memorandum to the Scottish Home Department drawing attention to the damage caused at fishing stations on all sections of the Scottish coast and requesting immediate action with a view to reducing the numbers of seals.

THE NUMBERS AND DISTRIBUTION OF SEALS ROUND THE BRITISH ISLES

The salmon fishermen's case against seals is partly based on the belief that the numbers of these animals have increased on all Scottish coasts since the passing of the Grey Seals Protection Act 1932. It is essential, therefore, to examine the position and at the same time to distinguish between the two species of seal as it is obvious, from public statements and from speeches reported in Hansard, that much confusion has arisen in the past through faulty identification.

Five species of seal have been recorded from British waters:

Halichoerus grypus (Fabricius)	grey or Atlantic seal
Phoca vitulina L.	common or harbour seal
Phoca hispida Schreber	ringed seal
Phoca groenlandica Fabricius	harp seal
Cystophora cristata (Erxleben)	hooded seal

The last three species, however, are rarely seen on our coasts so that they may be disregarded and attention focused on the two native species, the common and grey seals.

In the following survey of the distribution of seals the coastline is dealt with by regions and the estimated numbers or actual counts of seals are summarised according to the evidence of the various authorities.

TABLE I

SEAL COLONIES ON THE EAST COASTS OF ENGLAND AND SCOTLAND

Authority and Date of Publication	Area of Locality	Species of Seal	Numbers and Remarks
Sergeant (1951)	The Wash and Norfolk coast	common	= estimated 1,000–1,500, numbers maintained over previous 25 years in spite of persecution, possibly increasing.
Fishing News (1959a) . . .	The Wash and Norfolk coast	common grey	= estimated 2,500 = new colony established Scroby Sands Yarmouth.
Hickling (1957, 1958, 1959) . .	Farne Islands . .	grey	= estimated 600-800 in 1928; estimated 3,000, possibly 3,200 in 19[illegible] 3,200—3,400 in 1959.
Eggeling (1957) . . . Report of Nature Conservancy (1958)	May Island, Firth of Forth	grey	= one pup born in 1956 and one in 19[illegible] increasing numbers (reports by [illegible] spector of Sea Fisheries of counts 30 to 40 in 1958; counts up to 70[illegible] 1959).
Mr. J. H. Maxwell, Tayport (personal communication).	Firth of Tay . .	common and grey	= estimated 2,000 in 1959.
Moray Firth Salmon Fisheries Company (personal communication) . .	firths of inner Moray Firth, River Spey to Dornoch .	common	= estimated 2,000 in 1958; number killed 1955–1959 inclusi[illegible] more than 1,100.
Harvie-Brown and Buckley (1887) .	Caithness coast . .	grey	= breeds in sea caves.

East Coast of England and Scotland

Table I briefly summarises what is known of seals on the east coast of Scotland and England. Numerous complaints concerning seal damage to fisheries on the Yorkshire coast have appeared in trade journals in recent years (*Fishing News*, 1958a, b, c, d, 1959a, b). The seals which gave rise to these complaints have not been identified but it is known that grey seals from the Farne Islands move south, probably to feed, and it is possible that common seals move northwards from the Wash for the same purpose.

Tagging experiments on the Farne Islands (Hickling 1957) have shown that seals from this breeding colony migrate to the coasts of other countries bordering the North Sea. This movement, however, cannot be of any great magnitude since the grey seal populations of all North Sea coasts, except that of the United Kingdom, are insignificant at all times of the year (Kristensen 1959; Vik 1959; Drs. A. V. Tåning, P. Korringa, G. Svärdson and W. Nolte, personal communications). While Mrs. Hickling's records show an appreciable movement of seals southwards from the Farnes along the English coast the main migration is northwards to the Scottish coast. Recoveries have been made from various places as far north as the Moray Firth and in one exceptional case from the Faroe Islands. Such emigrations are in accordance with the evidence that the Farnes colony in the space of thirty years has multiplied by four or five times (Hickling 1957) and find support in the very marked increase in the numbers of grey seals on the Scottish east coast in recent years. This increase has been particularly noticeable near May Island in the Outer Firth of Forth and on the coast of Angus.

A breeding colony of common seals has existed in the Firth of Tay for a very long time. The numbers in this area have fluctuated over the years but Mr. J. H. Maxwell of Tayport, a seal hunter and naturalist with over fifty years' experience, has estimated the population in 1959 to be about 2,000. Mr. Maxwell in one of his letters also referred to the presence of grey seals in the estuaries, particularly near the mouth of the River Eden. In order to confirm this information the heads of seals shot in the Outer Firth of Tay from June to September 1959 were examined at the Marine Laboratory, Aberdeen. In a total of 35, 26 were common seals and 9 grey seals. As this investigation covered the pupping season for common seals, the 26 common not unexpectedly included at least 12 pups up to the middle of August. The figures, therefore, show a bias in favour of the common seal. It is also interesting to record that two of the grey seals, which appeared to be mainly adults, were females carrying young. These were killed on 17th August and 24th September, which suggests that they would have given birth to their pups locally, although the breeding of this species in the Tay has not yet been confirmed by the discovery of white-coated pups.

Between the two great wars, seals were comparatively rare on the section of coast between Montrose and Aberdeen and those identified were invariably common seals. Since 1945, however, salmon fishermen have reported an increase in the number of seals in this area and particularly since 1954. From 17th March 1958, 60 seals killed on this stretch of coastline have been examined at Aberdeen; 41 of these were grey seals and 19 common seals.

Seals have also been concentrating at Scotstown Head and at Rattray Head, in north-east Aberdeenshire. Attempts to procure specimens for identification have so far failed but from reports received it would appear that both species are present in this locality.

On the southern shore of the Moray Firth, an area in which some of the worst damage to salmon fishings has been experienced, both species of seal are again present (*Aberdeen Press and Journal*, 1958, 1959a). This has been confirmed by the examination of eight seals killed between Gardenstown and Lossiemouth, five of which were greys and three commons.

Of the 46 grey seals examined from the coast between Montrose and Lossiemouth, 6 were very young animals, details of which are given in Table II. To these must be added another record of a white-coated pup seen on the beach at Cruden Bay in November 1957. These isolated cases of pups, occurring at considerable distances from the nearest established breeding colonies on the Farnes and at Orkney, suggest local breeding by individual animals at points on the intervening coast. The occurrence of gravid females so late in the year in the outer Firth of Tay is another pointer to the same conclusion and the existence of sea caves not readily accessible to human beings in certain localities,

such as the coasts of Angus and of Aberdeenshire in the vicinity of Pennan and Troup Heads, are features which encourage this view. Indeed, salmon fishermen at Pennan firmly believe that grey seals breed in the local sea caves.

TABLE II

DETAILS OF GREY SEAL PUPS FROM SCOTTISH EAST COAST

No.	Date	Locality	Length in inches	Remarks
1	21.11.58	Montrose Basin .	38½	white coat
2	27.11.58	Johnshaven .	39	second coat
3	9. 2.59	Johnshaven .	40	second coat
4	6.12.59	Aberdeen beach .	39	moult incomplete
5	11.12.59	Gardenstown .	35½	,, ,,
6	27.12.59	Aberdeen beach .	41	,, ,,

During 1958 and 1959 six seals bearing Farne Island tags were killed on the coast between Montrose and Johnshaven, and in the first quarter of 1960 recoveries were made from Newtonhill, Kincardineshire and from the Firth of Tay. These, however, are not all the tagged seals recovered. The writer is aware of tags recovered near the mouth of the River Ythan on the Aberdeenshire coast at the end of 1958 and near Portlethen village in the spring of 1959, which for different reasons were unfortunately not returned to the tagging authorities. Furthermore, at least three of the seals examined at the Marine Laboratory during 1959 exhibited perforations or wounds in a rear flipper indicating the possible loss of tags. Two of these animals were recovered from near Montrose and one from Gardenstown in Banffshire. This failure to recover tags cannot be disregarded, so that the numbers of seals killed on the salmon fishings of the east coast and originating from the Farne Islands are certainly greater than tagging results suggest.

It must be concluded, therefore, that the big increase in the grey seal population of the Farne Islands has resulted in a greater influx of these animals to Scottish coastal waters. It would appear, too, that overcrowding on the Farnes has forced some animals to seek new breeding grounds, for example on May Island, and possibly at other points on the coast. The possibility of seals having moved southward from the Orkneys cannot be ignored altogether, but, having regard to the adequate feeding in northern waters and to the numerous suitable breeding places in the Orkneys, this seems less likely.

Westwards from Lossiemouth and within the Inverness, Beauly, Cromarty and Dornoch Firths the seals are predominantly common seals. In this area their numbers have increased since the last war to such an extent that owners of salmon fishings have been forced to take collective action. During the five year period ending 1959 more than 1,100 seals were killed in this area but in spite of this destruction the stocks appear to be maintained. The seal population of this area has been estimated at 2,000, and considering the yearly toll being taken this does not seem excessive and may indeed be an underestimate.

Grey seals, however, are again predominant on the Caithness coast. Statements by salmon and marine fishermen both before and since the last war indicate that they continue to breed in the local sea caves as they did at the end of the last century (Harvie-Brown and Buckley 1887). It is generally agreed, however, that the numbers originating from cave-breeding colonies are small in comparison with those from open beaches. It is likely, therefore, that the concentrations of grey seals now hauling out on the Pentland Skerries, Swona and Stroma at the eastern end of the Pentland Firth are derived to some extent from other breeding grounds, probably to the north.

North Coast of Scotland, Orkney and Shetland

References to seal colonies in this region are given in Table III. The first indication of an increase in the numbers of seals in the Orkneys was given by Gunn (1932) who wrote 'according to some quite recent reports this seal (grey) is now frequenting the more land-locked waters among the islands'. The extension of the grey seal's distribution in the Orkneys has been indicated by local reports of the establishment of colonies at various places on the western side of the islands including the entrance to

Scapa Flow, but the most conclusive evidence of this increase has been provided by Captain G. Harcus, master of the inter-islands' steamer *Earl Sigurd* (see Table III).

TABLE III

SEAL COLONIES ON THE NORTH COAST OF SCOTLAND, IN ORKNEY AND IN SHETLAND

Authority and Date of Publication	Area of Locality	Species of Seal	Numbers and Remarks
Buckley and Harvie-Brown (1891)	Orkney	common	= numerous.
		grey	= not common but refers to large numbers killed on Sule Skerry.
Gunn (1932)	Orkney	grey	= mainly confined to Seal Skerry, North Ronaldsay, but increasing in numbers
Duffey (1955)	Eynhallow, Orkney	common	= counts ranging from 40–200
		grey	= counts from 10–20.
Capt. G. Harcus, Kirkwall (personal communication)	Green Holms, Orkney	grey	= estimated 800–900 adults and 400 white-coated pups 18th November 1958; total population estimated 1,200–1,400, 6th January 1959.
	Rusk Holm, Orkney	grey	= not uncommon to see 500–600.
Evans and Buckley (1899)	Shetland	common	= abundant.
		grey	= much scarcer than common.
Fishing News (1949)	Shetland	grey	= big increase in numbers.
Venables and Venables (1955a, 1955b, 1957, 1959)	Shetland	grey	= breeding colonies, Ve Skerries, Muckle Flugga, Out Skerries, Mainland (northern end—in 1951, 200 pups counted).
,,	Fitful Head, Shetland	common	= counts 26th August, 1956—428 including pups; 25th May 1958—274.
,,	Yell Sound, Shetland	common	= large breeding colonies.
,,	Mousa, Shetland	common	= count 25th May 1958—175.
Mr. Venables (personal communication)	Fitful Head, Shetland	grey	= cave breeding colony—counts in vicinity, 84, August 1956; 135, May 1958.
Mr. J. Peterson, Lerwick (personal communication)	Shetland	grey	= breeding on Fetlar and presence of herds on Fair Isle and Foula.
Lockley (1954)	Caithness, Orkney and Shetland	grey	= estimated 1,000 pups born yearly.
Darling (1948)	Whiten Head caves	grey	= annual production of pups less than 100.

Confirmation of these developments was obtained by the author during a visit to Orkney in December 1959. About 300 grey seals including 50 pups were counted on the Lesser Green Holm. Large numbers were also present on the Greater Green Holm although the combined total for both islands appeared to be less than Captain Harcus's estimate of the previous year. Variations in seal counts even from day to day are of course not uncommon but the smaller numbers on the Green Holms in 1959 could possibly be explained by the return of many seals to a recognised breeding place on Wart Holm, which they had temporarily deserted in 1958 owing to salvage operation on a wreck. Reports were received of very heavy concentrations of breeding grey seals on Wart Holm and on the neighbouring Rusk Holm. In recent years a grey seal breeding colony has become established in South Ronaldsay, where 100 pups were born in October 1959.

Another new colony was reported in Stronsay and confirmation was obtained of colonies previously known to exist at places such as Nouster Bay (North Ronaldsay), Point of Avelshay (Rousay), Eynhallow, Gairsay, Sweyn Holm, Vasa Skerry and at Bu Point, Pegal Bay, Rysa Little and other places in Scapa Flow. Most of these localities have hitherto been regarded as common seal colonies but recent observations clearly show infiltration by grey seals. Duffey (1955), quoting Professor Wynne-Edwards, referred to small numbers of grey seals in association with common seals on Eynhallow. Mr. J. G. Marwick of Stromness, in a personal communication, mentions the appearance of grey seals at the western entrance to Scapa Flow and in December 1959 confirmation was obtained of the presence of this species in the Bay of Ireland, an offshoot of the Flow. In this connection it is interesting to note the unsolicited view of Mr. J. Langskaill, a local lobster fishermen and seal hunter, that the grey seal is displacing the common seal in some sheltered localities such as Westray Firth and possibly also Scapa Flow. This would appear to indicate a continuation of the trend referred to by Gunn. It should also be mentioned that members of Orkney angling societies are firmly of the belief that the decline in catches of sea trout since the war is due in some measure to greater numbers of seals near burn mouths.

Further evidence was obtained of the concentrations of grey seals on Swona, Stroma, the Pentland Skerries, Copinsay and Auskerry. Although breeding has not so far been confirmed on any of these islands, it is possible, according to observations by fishermen, that small numbers of pups may be born in the caves of the first two.

With the exception of a cave-breeding grey seal colony in the vicinity of Whiten Head and Cape Wrath, no major colony of either species is known on the north coast although seals presumably from Orkney and North Rona cause considerable damage to salmon fishings in this area and have done so since the early 1920s (Magniac 1929). The grey seal formerly bred on Sule Skerry but so far no evidence has been obtained to show a resumption of breeding, although seals are regularly seen on the rocks near the lighthouse.

The first published record of an increase in the numbers of grey seals in Shetland was given by the editor of the *Fishing News* in 1949. This increase was confirmed by observations from fishery research ships before and after the Second Great War. Venables and Venables (1955a) refer to the various breeding colonies including three localities in Mainland (Uyea Isle, Hevdadale Geos and Gruney) where about 200 grey seal pups were born in 1951 (see Table III). The common seal is also numerous in Shetland where it has been the subject of research by Mr. and Mrs. Venables.

It may be concluded that while there is evidence of an increase in the numbers of grey seals in Shetland, this increase does not appear to be so remarkable as in Orkney. The rather greater amount of shooting of seals that takes place in Shetland may have helped to keep the numbers in check but on the other hand it may be that less is known of the distribution and breeding places of the species on the exposed and less accessible parts of the coast. In Orkney a very marked increase in the numbers of grey seals has taken place in the last thirty years. This has been accompanied by the establishment of several new breeding colonies and by the invasion of sheltered waters previously the undisputed haunts of the common seal. Lockley's (1954) estimated production of 1,000 grey seal pups annually in Shetland, Orkney and Caithness now appears to be an underestimate.

West Coast of Scotland and the Hebrides

Numerous references to the grey seal appear in scientific periodicals and in general works on the natural history of the west of Scotland. The more important of these are summarised in Table IV.

The breeding colony of grey seals on North Rona is now regarded as the largest concentration of this species in the world. Darling's researches have shown that a very marked increase in the population of grey seals took place during the 1930s and prior to the last war he estimated the North Rona colony to be about 5,000, with an annual production of about 1,500 calves. Returning to the island after the war Darling was unable to go ashore but observed an extension of the breeding herds. Recent suggestions (Smith 1958; *Scotsman* 1958) indicating a reduction in the stocks have been refuted by Boyd (1958) who writes: 'The seal herd today appears to be as large, if not larger, than on the date of Darling's visit. From press and radio statements by members of the Nature Conservancy, who visited the island toward

the end of 1959, this view would appear to be more than justified. On this occasion the crop of pups for 1959 was put at 2,200. Employing the usual formula in such cases this would indicate that the total grey seal population based on North Rona is now somewhere between 6,500 and 8,000.

TABLE IV

SEAL COLONIES ON THE WEST COAST OF SCOTLAND

Authority and Date of Publication	Area of Locality	Species of Seal	Numbers and Remarks
Harvie-Brown and Macpherson (1904)	N.W. Highlands and Skye	common	= numerous.
		grey	= rare along west coast of mainland of Scotland and Skye.
Darling (1939, 1947) . . .	North Rona . . .	grey	= annual production of pups estimated at 1,500, total population estimated at 5,000.
Darling (1948)	Hebrides . . .	grey	= chart of breeding colonies including 3 producing less than 1,000 pups, 2 less than 100, 4 less than 10.
Fisher and Piercy (1950) . .	Bulgie Island (south of Cape Wrath)	grey	= c 100 counted but no breeding.
Gordon (1951), Atkinson and Roberts (1952), Boyd (1957)	Gaskeir . . .	grey	= count November 1950, 700–800 pups (indicating total population 2,250–3,000); Boyd on basis of smaller count estimated total population 1,800–2,400.
Hewer (1957)	Shillay . . .	grey	= count 160 pups, total population estimated 600.
Roberts and Atkinson (1955) .	Haskeir . . .	grey	= counts up to 120; formerly chief breeding place in Hebrides.
Boyd (1955)	Kearstay . . .	grey	= in September 1954 count 9 pregnant cows and one newly born pup.
Wilson (1915)	Skerryvore . . .	grey	= counts 60-80, white-coated pups at end of year.
Boyd (1955)	Gunna . . .	grey	= count 14 including 6 pups.
Darling (1948)	Treshnish Isles . .	grey	= large colony, no count but production of pups less than 1,000.
,,	skerries of S.W. corner of Mull	grey	= small colony producing fewer than 10 pups yearly.
,,	Oronsay . . .	grey	= colony producing fewer than 100 pups yearly.
Hewer (1957)	Oronsay . . .	grey	= count total population 400-500 including at least 117 pups.

Darling (1948) indicates, by means of a chart, six breeding places of the grey seal on the western side of the Outer Hebrides and distinguishes between those producing less than 10, less than 100, and less than 1,000 pups annually. The two large colonies each accounting for less than 1,000 pups annually are obviously Gaskeir and Shillay. The former has been visited on several occasions since the last war and various counts and estimates have been made of the total seal population (Table IV). The seal stocks on both Gaskeir and Shillay have clearly increased considerably since the passing of the first Grey Seals Protection Act. Darling's third largest seal colony in the Outer Hebrides, producing fewer than 100 pups yearly would appear to be Haskeir which at one time was the chief grey seal breeding place in the

Hebrides. This colony, however, has gradually declined in its output of pups over the last forty years concurrently with the growth of the Gaskeir colony.

Although Darling does not name the three minor breeding colonies in this region they would appear to be on the Taransay Glorigs, Causamul and the Monach Isles. Boyd (1955) records yet another small breeding colony on Kearstay where, according to the local people, seals had bred throughout the lifetime of the present community. Warwick (1938) states that grey seals are commonly seen off the coast of Barra and on neighbouring rocks and islets.

In 1958 the Inspector of Sea Fisheries for north-western Scotland reported that both species of seal had increased considerably during the previous twenty years and that grey seals in particular had appeared in greater numbers within the last five years on the west side of the islands, in Loch Bhrollum and on the Shiants.

Coming to the Inner Hebrides, Darling's chart shows one breeding place, obviously the Treshnish Isles, producing less than 1,000 pups yearly, another producing fewer than 100, which would appear to be Oronsay, and a small colony with fewer than 10 pups on skerries south-west of Mull. Rather surprisingly, no reference is made to Skerryvore, where Wilson (1915), a lighthouse keeper, reported counts of up to 80 grey seals every year and numbers of white-coated pups towards the end of the year. Recent enquiries reveal that grey seals continue to frequent Skerryvore and that white-coated pups were seen there in January 1960. Hewer (1957) visited Oronsay and found at least 117 pups, which indicates an appreciable increase on Darling's figure. Darling's chart also shows a number of small islands where grey seals had been known to breed in the past but where in 1948 they were no longer doing so. More recently, however, Boyd (1955) has found grey seals breeding regularly on one of these islands, Gunna, between Coll and Tiree.

Grey seals are also known to have bred on St. Kilda which, according to Darling, was not a breeding place in 1948. The report of the Nature Conservancy for 1958, however, reveals that the species is again breeding on St. Kilda and that pups were born on the beach of Village Bay, an event of which there is no previous record for the island.

This review of the literature leaves no doubt that the grey seal has increased in numbers in both the Outer and Inner Hebrides over the past forty years and even within the last ten or fifteen years. Not only are the numbers greater but the species is returning to old breeding grounds and in some cases has been found to have bred on islands for long periods, of which no published record exists.

In addition to the established breeding colonies, concentrations of grey seals are known to occur at other places. Reference has already been made to the Shiant Islands and to Bulgie Island. Mr. W. Muir, of Achiltibuie, has stated that 40 grey seals may now be seen on the Summer Isles at the entrance to Loch Broom where only one was to be seen twenty years ago. Salmon fishermen from Gruinard Bay to Loch Torridon, despite continual shooting and poisoning, continue to suffer from grey seal activities. Increasing numbers have also been reported by fishermen on the east side of Skye and on Raasay and herds of up to 70 have been observed on the west coast of Skye. Rintoul and Baxter (1950) found them 'numerous' in Gigha Sound and Borland and Walls (1951) observed them in 'fair numbers' off Sanda, at the entrance to the Firth of Clyde. No breeding colony, however, is known to exist on the west coast of the mainland of Scotland, so that the grey seals referred to in this paragraph are probably on their feeding grounds which many of them will desert as the breeding season approaches.

There is little evidence in the literature of the common seal's presence on the exposed coasts favoured by the grey seal. A reference to common seals on the Monach Isles (Allan 1955) would appear to be due to faulty identification. Nevertheless, this species is known to be abundant in some of the Scottish sea lochs, although even here naturalists have given it little attention and no estimate of numbers has been attempted. Counts of up to 70 have been recorded from the entrance to Loch Creran and there is evidence of its presence in considerable numbers in Loch Linnhe and in the vicinity of Oban. It is also numerous in the Firth of Clyde where it has been troublesome since the early 1930s. Despite regular shooting by fishermen, the stocks have increased along the Ayrshire coast from Ballantrae northwards. Confirmation of this increase has been given by the Inspector of Sea Fisheries for south-western Scotland. A count of 200 was made on a two miles stretch of coast north of Ardrossan in 1958. Although the grey seal has been recorded from the Firth of Clyde (Gray 1900) the damage to salmon fishings on the Ayrshire coast has

hitherto been attributed entirely to common seals. During 1959, however, two seal carcases were sent to the Marine Laboratory, Aberdeen, for identification. One of these proved to be a grey seal and subsequent examination by fishermen of seals killed in this area has indicated that the grey seal forms an appreciable proportion of the total.

On the Wigtownshire coast seals threatened salmon fisheries for the first time in the early 1930s; prior to this they had been almost unknown in this locality. The animals in this case were identified as grey seals and despite shooting by fishermen they appear to have maintained themselves in the area.

Five out of six salmon netsmen consulted on the northern shore of the Solway Firth, between Luce Bay and Gretna, have reported no interference to their nets by seals. The single exception, operating in the inner firth between the rivers Annan and Nith, has recently experienced some damage by both common and grey seals. It is significant, too, that four of the six netsmen have been finding seal-damaged fish in their catches. An explanation of this desertion of the outer firth by seals may be the present use of their former hauling out rocks and skerries in Luce Bay as a bombing target by the Royal Air Force. It is interesting to note the discovery of a white-coated grey seal pup on a salt marsh, half a mile above Kippford on the River Urr in Dumfriesshire, on 5th October 1959. As this paper goes to press the head of a large seal caught in a stake net near Annan has been identified at Aberdeen as that of an adult grey seal.

West Coast of England, Wales and Ireland

References to seal colonies in this region are summarised in Table V. In addition to the colonies listed, Duncan (1952) refers to the presence of small numbers of grey seals on the north coast of Wales

TABLE V

SEAL COLONIES ON THE WEST COAST OF ENGLAND, IN WALES AND IN IRELAND

Authority and Date of Publication	Area of Locality	Species of Seal	Numbers and Remarks
Steven (1934, 1936)	Cornish coasts	grey	= esitmated total 300–500.
Davies (1956)	Cornish coasts	grey	= estimated total about same as Steven's.
,,	Scilly Isles	grey	= total population 50, remaining constant.
Davies (1953)	Lundy Island	grey	= population of c 100, possibly some breeding in caves.
Davies (1949)	Welsh coast, Aberystwyth to Skokholm	grey	= total population c 1,000, breeding colonies.
Duncan (1952)	Isle of Man	grey	= total population c 50, some breeding.
Lockley (1954)	east coast of Ireland	grey	= two colonies which with Welsh and Cornish colonies produce c 500 pups annually.
,,	west coast of Ireland	grey	= four colonies producing total of 500 pups yearly.

and Hardy (1953) to their occurrence in the estuaries of the Dee and Mersey. Small grey seal colonies also exist on Bardsey Island and on the Anglesey Skerries but the main concentrations of this species are on the Welsh coast from Aberystwyth to Skokholm.

The common seal is known to have bred in the Dee and Mersey in the early 1930s but there is little indication of this at the present time. Although Matthews (1940) mentions the establishment of a small breeding colony of this seal in the Bristol Channel between the two wars the species is far less numerous on the coasts of Wales and Western England than the grey seal. Duncan points out that the common seal is absent from the Isle of Man and that the grey is the more numerous species on coasts round the southern Irish Sea and St. George's Channel. Steven (1936) concludes that the common seal, if it does occur on the Cornish coasts, must be very rare.

It has been suggested that the grey seal is declining in numbers in Cornwall (Grey and Hickling 1958) and even 'almost exterminated' (Hansard, 28th July 1958, page 1095), but Davies (1956) states that the stock is still about the same as estimated by Steven.

Summary of the State of Seal Stocks in Great Britain

There is abundant evidence from this survey that the grey seal has been steadily increasing since the passing of the Grey Seal Protection Act in 1914. At first this was evident on the west coast only but by the 1930s stocks were increasing at Orkney. There appears to be little doubt that the reduced fishing effort and general concern with other matters during both great wars permitted the growth of grey seal and probably also of common seal stocks. In any case a very marked increase in the numbers of the grey seal, accompanied by an extension of its breeding places, has been observed since the end of the Second Great War, but more particularly in the course of the last five years. Six years ago Lockley (1954) estimated the British population of the grey seal to be about 20,000. On the basis of the information contained in Tables I and III to V inclusive and from replies to enquiries made throughout the country during the last two years there are grounds for believing that the stocks now number between 22,000 and 25,000 and that 80% of this total is resident in Scottish waters. This increase is all the more remarkable when one considers the high death rate among seal pups (Davies 1949; Coulson 1959).

The position as regards the common seal is obscure. With the exception of the work by Mr. and Mrs. Venables and by Dr. Sergeant, the common seal has been relatively neglected by investigators in this country. In general, however, this species is more localised in its distribution than the grey seal and although increases have been observed in recent years, notably in the Wash and in the Dornoch Firth area, there is no evidence of the overall increase noted in the grey seal. One remarkable feature of this investigation has been the number of places in which concentrations of seals, until recently regarded as common seals, have been found to include remarkably high proportions of grey seals. This is particularly applicable to the Outer Firth of Tay, the Angus coast, the Outer Moray Firth, Orkney and the Ayrshire coast. Although it is impossible to risk an estimate of the common seal population the evidence of this review appears to confirm the statement by Morrison-Scott (1952) that it is now less numerous than the grey seal in British waters.

THE FOOD OF COMMON AND GREY SEALS

Salmon fishermen also maintain that seals kill and eat large numbers of salmon. As this claim is frequently denied by those supporting the protection of seal stocks it is essential to examine the available evidence.

Evidence from Seal Literature

Numerous references to the food of seals appear throughout the extensive literature dealing with these animals and several papers are devoted entirely to this subject. For convenience, the literature will be considered on a regional basis.

North-western European coasts excluding the British Isles

A list of European authorities is given in Table VI along with the species of seal studied, the region to which the observations refer and the names of the various items identified in the stomach contents.

On the Norwegian coast at the beginning of the twentieth century, more salmon were destroyed by seals than were caught by fishermen (Hjort and Knipowitsch 1907; Wollebaek 1907). Seals frequently attacked fish in nets. Although the grey seal was at that time less numerous in Norwegian waters than the common seal it nevertheless was troublesome to line fishermen by taking halibut, cod and ling off the hooks. Occasionally grey seals were caught on the hooks.

In the first decade of the present century, according to Knipowitsch (1907), the grey seal was the most destructive of the three species of seal native to the Baltic Sea. Considerable losses were incurred by seals taking fish from nets and by damaging gear. At the beginning of the century the value of fish

destroyed by seals in the Baltic was estimated at between five and nine million kroner yearly. Schubart (1929) also regarded the grey seal as the most destructive species on the German Baltic coast and referred

TABLE VI

FOOD OF SEALS ON NORTH-WESTERN EUROPEAN COASTS (EXCLUDING THE BRITISH ISLES)

Authority and Date of Publication	Area of Locality	Species of Seal	Food
Nehring (1886)	German North Sea coast	common	= fish, plaice, flounder, molluscs, shrimps, crabs.
Wollebaek (1907)	Norwegian coast	common and grey	= salmon, halibut, cod, ling, herring.
Vik (1959) (quoting Sivertsen in "Norges Dyreliv")	Norwegian coast	grey	= halibut, flounder, ling, cod, herring, salmon, etc.
Knipowitsch (1907)	Baltic coasts	grey	= salmon, cod, herring.
Schubart (1929)	German Baltic coast	grey	= salmon, *Coregonus*, Cyprinidae.
Metzelaar (1921-22)	Netherlands	common	= flounder, common dab, plaice, common sole, herring, salmon, common eel, cod, sparling, anchovy, shrimps, crabs, molluscs.
Havinga (1933)	Netherlands	common	= plaice, flounder, common dab, common sole, cod, whiting, herring, twaite shad, anchovy, gurnard, sea scorpion, viviparous blenny, common goby, garfish, thornback ray, sandeel, gunnel, sparling, river lamprey, armed bull-head, cuttlefish, shrimps.

to its habit of raiding and damaging fishing lines, drift nets and anchored nets and of leaving the heads of salmon as evidence of its visit. In recent years Svärdson (1955) has stated that all three species of seal in the Baltic (common, grey and ringed) are known to eat salmon and that the grey seal continues to be the most serious predator on the salmon, particularly in consequence of its habit of raiding fishing nets.

In his comprehensive investigation of the food of common seals on the coast of Holland, Havinga (1933) includes an analysis by weight of the principal food types. This shows that the common flounder provides 30% of the total, whiting 17%, herring 15%, sea scorpion 16%, cod 4%, blenny 4%, plaice 3%, etc. Thus, about three-quarters of the food in Dutch waters consists of fish of some commercial or potential commercial importance while the remaining quarter includes fish of little or no direct economic value except perhaps for the manufacture of fish meal.

Other points brought out by Havinga's work may be summarised as follows:

1. The young, after weaning, feed on the shrimp, *Crangon vulgaris*, but this phase is of short duration —about 6 weeks.
2. The diet changes throughout the year; for example, in summer rather more flat-fishes are eaten and in winter rather more whiting, blenny and sea scorpion.
3. The bigger seals tend to prey more on bigger fish.
4. Although most of the fish eaten are the young of commercially important species it is not unusual to find flat-fishes (flounder, plaice and sole) of up to 30 cm length in the stomachs.
5. The most important individual fish, the flounder, provides 64% of the food weight of seals greater than 150 cm in length but only 23% of that of smaller seals.
6. Seals are known to devour herring caught in nets.
7. Feeding occurs during daylight and mainly at high water.
8. The average daily consumption of food by the common seal is estimated at 5 kg (11 pounds).
9. No evidence was obtained in support of the view that seals eat diseased or weak specimens.
10. In many areas along the Dutch coast seals are reckoned to kill more flounders than fishermen do.

British Coasts

Table VII summarises the results of British authorities on the food of seals but the following additional items of interest are worthy of attention:

TABLE VII

FOOD OF SEALS ON BRITISH COASTS

Authority and Date of Publication	Area or Locality	Species of Seal	Food
Millais (1906)	British coasts	common	= whiting, pollack, cod, saithe, eels, flounders, salmon, crustaceans, sea weeds.
,,	,, ,,	grey	= cod, saithe, pollack, ling, conger eel, 'toad-fish', 'lumpfish', salmon, sea trout, halibut.
Steven (1934)	Cornish coast	grey	= herring, cuttlefish.
Darling (1944, 1947, 1952)	Scottish coasts	common	= fish, crustaceans, starfish, salmon, sea trout.
,,	,, ,,	grey	= saithe, lythe, conger eel, salmon, flat-fishes, crustaceans.
Sergeant (1951)	The Wash	common	= molluscs, crustaceans, fish, plaice, flounder, common dab, whiting, sandeel, salmonid, pipefish.
,,	Norfolk coast	common	= fish, plaice, flounder, common dab, goby, skate, mussels, shrimps.
Hardy (1953)	Estuary of Dee, Cheshire	grey	= cod, flounder, other fishes.
Lockley (1954)	Welsh coast	grey	= fish, herring, mackerel, skate, ray, dog fish, conger eel, mussels.
Duncan (1956)	Isle of Man	grey	= saithe, bib, flatfish(?), crustaceans, sea weed.
Various, including fishermen	Brish coasts	common	= salmon, sea trout, common sole, cod, eel, skate, mackerel, flatfishes, crabs.
,,	,, ,,	grey	= salmon, sea trout, flatfishes, cod, ling, haddock, saithe, whiting, lythe, conger eel, pilchard, herring, brill, lumpsucker, wrasse, skate, dogfish, bass, grey mullet, crabs, lobsters.

Millais (1906) writes, 'Seals are exceedingly fond of salmon and the damage they do to the stake-net fishermen on the east coast of Scotland is not only to be estimated by the fish they take or the nets they destroy, for they keep the valuable fish constantly on the move and prevent them from coming into shallow water'. Reference is also made to the seal's 'artfulness' in taking fish from nets and evading all modes of capture. Millais concludes that the mischief wrought by seals on salmon is without doubt very great and adds that where fish have to pass through a narrow channel to enter certain Scottish rivers only a relatively small proportion of the fish succeed in doing so without suffering claw or tooth marks.

In the early 1930s Steven (1934), investigating complaints by Cornish fishermen about the robbing of nets and dispersal of fish shoals by seals came to the conclusion, quoted by Matthews (1940), that the numbers of grey seals should be controlled in the interests of the fishermen. Steven estimated the daily consumption of fish by the grey seal to be at least 15 pounds.

According to Darling (1947) the common seal has a catholic taste in fish, crustaceans and starfish. This species does much damage to salmon and sea trout when these fish are about to move up rivers

Its habit of penetrating rivers, occasionally into fresh-water lochs, also testifies to its predatory habits on salmon and sea trout. The grey seal, on the other hand, feeds largely on rock fish such as saithe, lythe, conger-eels and some crustaceans. Rather unobtrusively the same author adds, 'It is mostly yearlings (8-9 months old) which cause the trouble in the salmon bag-nets'. Later, referring to his investigation of the seal damage to salmon fisheries in the River Tweed, Darling (1952) concludes that with the great increase in the stocks of grey seals at the Farne Islands these animals were undoubtedly doing considerable damage to the Tweed fisheries.

Sergeant's (1951) work on the common seals of the Wash was mainly concerned with unweaned pups. Only a small proportion of the seals in this area contained food, which consisted of molluscs (92% of the total weight), fish (4%) and crustaceans (4%). As regards the older and larger seals from the open coast of Norfolk, however, Sergeant's results were in agreement with those of Havinga. He concluded that, locally, seals are harmful to inshore fisheries.

Lockley (1954b) refers to the belief of Welsh fishermen that the grey seal robs lobster pots and damages mackerel and herring nets and confirms having seen nets torn by seals. Evidence that lobsters are eaten by this seal has also been provided by O'Farrell (1959a, b) and by fishermen on the west of Scotland and in Orkney.

North American Coasts

Table VIII contains details of American papers on the food of the common and grey seals. The Scheffers and their colleagues describe the examination of over a hundred stomachs of the common or

TABLE VIII

FOOD OF COMMON (HARBOUR) AND GREY SEALS ON NORTH AMERICAN COASTS

Authority and Date of Publication	Area or Locality	Species of Seal	Food
Scheffer (1928); Scheffer and Sperry (1931); Scheffer and Slipp (1944) .	Coast of Washington, U.S.A.	common or harbour	= Pleuronectidae, Pacific herring, tomcod, hake, sculpins, pollack, surf-fish, cod, lingcod, blenny, rockfisher, singing fish, sandeel, Pacific lamprey, salmon (*Oncorhynchus*), silver perch, ratfish, crabs, shrimps, octopus, squid, crayfish, clam.
Fisher (1950)	Atlantic coast of Canada .	common or harbour	= fish, sardines, shrimps (young seals), squid.
Fisher and MacKenzie (1955) . .	Maritime Provinces, Canada	common or harbour	= herring, winter flounder and other flatfishes, hake, haddock, cod, smelt, shad rosefish, gaspereau, squid, shrimps, lobster.
		grey	= salmon, unidentified fish (? mackerel), cod, herring, hake, winter flounder and other flatfishes, dogfish, skate, squid, shrimps, lobsters.
Templeman, Squires and Fleming (1957)	Maritime Provinces, Canada . . .	common or harbour	= herring, trout, capelin, flounder, salmon, small inshore fishes, smelt, cod, Greenland cod, sculpin, sandeel, wrasse, eel, eelpout, pollack, mussels, crabs, shrimps, lobster, clam, sea weed.

harbour seal, *Phoca vitulina richardii*, from Puget Sound and Willapa Bay on the Pacific coast of the United States. Fish, which were found in all but two of the 81 stomachs containing recognisable matter, comprised 93·6% of the total volume of food, molluscs 5·8% and crustaceans 0·6%. The list of individual species identified in the stomach contents shows that the food consists predominantly of commercially

useful species with the Gadidae, Pleuronectidae and Clupeidae each appearing more frequently than any other family. Seasonal variations in the types of food eaten occur locally. Although the Scheffers results appear to minimise the importance of salmon in the diet of the common seal, they and their co-authors, nevertheless, were aware of the considerable havoc caused by seals in river estuaries during salmon runs on the Pacific coasts of Canada and the United States. They concluded that fishermen were justified in their demands for control of seals and recommended that the seal population should be kept to a minimum in the vicinity of river mouths, where commercial fishermen concentrate, and also near hatchery traps.

In a short paper on the seals of the east coast of Canada, Fisher (1950) states that the young of the common seal feed at first on shrimps, later turning to sardines and other small fish while the adults feed on almost any kind of fish available and on squid.

Fisher and MacKenzie (1955) show that seals prey mainly on fish of commercial importance and that seasonal changes in their food may occur with inshore and offshore movements of fish. They also refer to persistent reports by fishermen and by scientists of both species of seal eating lobsters. Wilder (1957) mentions similar reports.

Recent Studies of the Food of Seals on the Scottish Coast

The stomach contents of twelve common seals shot in the Dornoch Firth were examined during the summer of 1956. Ten of these animals were feeding on salmon while the contents of the remaining two stomachs were unrecognisable. The stomach contents included large vertebrae but no skull bones of salmon. Small ear-bones were also present but these together with traces of small crustaceans and molluscs were considered to have come from the stomachs of the salmon.

The stomach contents of seals killed on the Ayrshire coast in recent years have also been examined. Salmon and sea trout occurred in nearly all the stomachs during spring and summer while cod and flat-fish were eaten more frequently throughout the winter.

From March 1958 to March 1960, 71 seal carcases from the Scottish east coast were examined at the Marine Laboratory, Aberdeen. Thirty-nine were killed or drowned in salmon nets, four in cod nets and one on a small-line hook; the remaining twenty-seven were killed in the water or on the shore

TABLE IX

ANALYSIS OF STOMACH CONTENTS OF SEALS KILLED ON SCOTTISH EAST COAST 1958–1960

	Grey Seal	Common Seal
Number examined	47	24
Empty stomachs	23	15
Containing recognisable food	24	9
Feeding on:—fish	20	9
salmon	10	—
parr	—	1
sea trout	—	1
cod	7	—
haddock	1	1
whiting	1	3
gadoid	3	1
mackerel	—	1
horse mackerel (*Caranx*)	—	1
viviparous blenny (*Zoarces*)	—	1
common eel	—	1
skate (including eggs)	3	—
flatfish	—	1
Feeding on cephalopods	3*	—
Feeding on:—crustaceans	2	—
hermit crab	1†	—
Norway lobster (*Nephrops*)	1	—

*jaws only ? from stomachs of fishes eaten by seals.
†claws only ? from stomach of fish eaten by seal.

The contents of the stomachs of these animals, 47 of which were grey seals and 24 common seals, are listed in Table IX. Both species show a high proportion of empty stomachs but the contents reveal a marked difference in the diet of the two species. Despite a similarity in the general size of the animals, most of which were less than a year old, the grey seals were found to be feeding mainly on salmon and cod, whereas the stomachs of the common seals contained neither of these fishes (except for salmon parr) but included no fewer than eight different species six of which were not eaten by the greys. In view of the avidity with which the common seal is known to eat salmon on other sections of the coast these results are unusual and their significance is not obvious. It should be noted, however, that five of the common seals were killed in the estuary of the river South Esk and one in the River North Esk some distance above the upper tidal limit, whereas all the grey seals with the exception of one pup in its first coat were killed on the open coast. Furthermore, the common seals feeding on blenny, parr and common eel were among those killed in the estuary and in the river. This rather suggests a partial segregation of the two species of seal in those localities where both are present and that the bigger and stronger grey seal may be ousting the smaller species from grounds hitherto occupied by the latter. Some evidence of similar behaviour has been obtained from observers in Orkney—another region in which the grey seal has been increasing in numbers and distribution in recent years. Another difference in the food of the two species, not evident from Table IX, is that with one exception the grey seals had been feeding on big fish and no head bones were present in the stomach contents, whereas small but whole fish were found in most of the common seals. Of the total volume of food in the stomachs of the 24 grey seals containing food about 80% consisted of salmon and 18% of cod and other gadoids.

The high percentage of empty stomachs revealed in Table IX is a feature which is referred to by other observers on the food of seals. It should be noted, however, that six of the grey seals in the present investigations were pups, 35½ in. to 41 in. in length, one of which was still in its white coat and three of which were in the process of moulting. It is doubtful, therefore, if any of these animals had started to feed. About the same number of young common seals could be regarded as in the same category.

It is also interesting to record that in the case of two yearling grey seals with empty stomachs, the remains of salmon were found in the bagnets in which the seals were trapped and salmon flesh was also found in the mouth of one of these animals. Yet another young grey pup was killed as it surfaced near a fishing vessel with a cod in its jaws. The records of ten grey seals feeding on salmon and seven on cod could, therefore, legitimately be increased to twelve and eight respectively, that is to over one half and over one quarter of the number of stomachs containing recognisable food.

However, the question of the empty stomachs is worthy of further study. Havinga has shown that common seals are daylight feeders and that those killed in the morning seldom contain food. This could account for some of the empty stomachs in the present investigations as most of the seals killed or drowned in salmon and cod nets were discovered before 9 o'clock in the morning. On the other hand there is evidence from observations by Scottish salmon and marine fishermen, and also from Steven's (1934) investigations, that the grey seal sometimes feeds by night. Neither view, however, explains the discovery of seals with empty stomachs in nets along with the remains of salmon. Although only two cases occur in the present records the finding of seals in nets together with the remains of the fish they have eaten is a frequent experience of fishermen on the Scottish coast. Furthermore, salmon fishermen have often been puzzled by the appearance of oil on the surface of the water near the nets. This has been put down to oil from mutilated fish and the appearance of oil is regarded as indicating the presence of a seal. After consideration of these facts another explanation of the occurrence of oil on the water would appear to be that the seal, on finding itself trapped, panics, and, in its anxiety to escape vomits its stomach contents and defaecates so that little or no trace of food is found in its gut. Evidence in support of this explanation of the frequency of empty seal stomachs is also provided firstly by the discovery of well digested food particles in samples of water taken from oily patches near salmon nets and, secondly, by the fact that many of the seals caught in nets and recorded as feeding contain only traces of food—again suggesting the loss of the contents through vomiting. Moreover, of three grey seals and four common seals shot in the sea at varying distances from nets, presumably while fishing, all except one common seal were found to have fairly full stomachs, the three greys, incidentally, each containing from 8 to 12 pounds of salmon. This also seems to indicate that empty or nearly empty stomachs result from the fear which seizes the

animals on finding themselves unable to escape. This view is in no way affected by the occasional discover of live salmon and other fish in nets along with a seal. On the contrary, this experience seems to strengthe the view that on finding itself trapped, the seal may panic to such an extent, particularly if surprise by fishermen, that it even ignores fish in the net.

It seems fairly certain, therefore, that the number of stomachs containing food in Table IX coul have been higher and that the number of grey seals feeding on salmon and cod could also have bee higher.

Discussion of the Food and Feeding Habits of Seals

A study of seal literature reveals that more is known of the food and feeding habits of common an grey seals than some public statements seem to imply. In the first place there is an overall similarity i the food of the two species throughout their lives. In each case the young, after weaning, begin feeding o small crustaceans and molluscs. Havinga states that the shrimp-feeding phase of the common seal's lif is comparatively short but, however long it may be the diet changes to include small fish and, later bigger fish. There is evidence that the size of the prey increases with the growth of the seal. It seem probable, therefore, that the more rapidly-growing grey seal will pass through the crustacean- an mollusc-eating stage and take to feeding on fish more quickly than the common seal. Indeed there i support for this view in the frequency with which young grey seals, a few months or even weeks old, ar found in salmon nets, along with the heads and other remains of the fish they have eaten and also i the presence of fragments of large fish in the stomachs of some of these animals.

The most obvious conclusion to be drawn from the literature and from recent research, howeve is that the food of adolescent and adult seals of both species consists predominantly of fish. Statemen or inferences to the contrary, therefore, would appear to be based on unreliable information (see Hansar 26th Nov. 1929, p. 1341, and Gray 1935). Considering the wide distribution of both seals in relation the limited distribution of many fishes, it is not surprising that the food varies. Nevertheless a similari in the types of fish eaten is recognisable from one region to another and the recurrence of representativ from certain families is a feature of considerable significance. These are the cod (Gadidae), herrin (Clupeidae), flatfish (Pleuronectidae) and salmon (Salmonidae) families, each of which is of hig economic importance.

However, differences in the diet of the two species have been noted from place to place in Europea waters. The common seal, frequenting sheltered waters and hauling out to rest mainly on sandbank feeds largely on the young of whiting, cod, etc., on flatfish and, locally, on shore fishes. The grey sea on the other hand, inhabiting rocky and exposed coasts, preys more on the larger gadoids and on cong eels. Although herrings are eaten by both seals the common seal feeds chiefly on the young fish i estuarine waters while the grey seal concentrates on the adult shoals offshore. Both species have a tast for the Salmonidae, however, and appear to take advantage of the coastal concentrations of these fis as they approach river mouths. Changes also occur in the food of seals with the seasonal offshore an inshore movements of fish.

Havinga has shown that 36% by weight of the common seal's diet on the Dutch coast consists o flatfish, 21% of the cod family, 15% of herring and 25% of various shore types of little or no econom value such as *Cottus*, *Agonus*, *Zoarces* and *Gobius*. Where similar ecological conditions exist on Briti coasts it may be assumed that the food of the common seal may be roughtly the same as on the Dut coast. This has to some extent been demonstrated by Sergeant on the Norfolk coast but in parts of Scotlan where the fish population also consists of flatfish and the young of gadoids and herring, for example, i the Dornoch Firth and on the Ayrshire coast, the principal food of the common seal over the greater pa of the year is salmon and sea trout. This seems to indicate a preference on the part of this seal for th Salmonidae which, of course, are numerous in Scottish waters but much scarcer on the coast of Hollan Such a preference is not unexpected, however, if one considers the size of salmon and sea trout in relatio to young flatfish, whiting and herring and the greater ease with which a seal can obtain a meal from on large fish than from scores of small individuals.

Turning to the grey seal it is interesting to note the eagerness with which certain popular writers emphasise the importance of rock fishes and species of little economic value in the diet of this animal. There is no doubt that on certain parts of the Scottish west coast the grey seal feeds largely on lythe, saithe and conger eel; nevertheless it has been observed killing and eating salmon in this region (Berry 1934-5; Macintyre 1934) and this has been the experience of many salmon fishermen on all Scottish coasts. Berry sums up 'Luckily, perhaps, on the east coast the grey seal is not very abundant, and spends much of its time in deep water. I question therefore whether salmon form more than a relatively small proportion of the normal diet of this species, except at the mouths of certain west coast rivers where grey seals are still dangerously plentiful'. Since Berry's report, however, the situation has altered considerably as a result of the increase in the numbers of grey seals on both east and west coasts in the last thirty years (Darling 1939, 1947, 1952; Buxton and Lockley 1947-48; Davies 1956; Eggeling 1957; Hickling 1958, 1959, etc., see pp. 4-12)

It may be concluded, therefore, that common and grey seals will eat any kind of fish available to them and that the apparent differences in the diet of the two species are due more to ecological differences in the habitat and to the seasonal habits and movements of fish rather than to a preference on the part of the seals for any particular fish. This view has already been expressed on several occasions—thus Schubart (1929), 'The food of seals consists primarily of fish of all kinds'; Scheffer and Sperry (1931), 'Contrary to occasional reports from particularly prejudiced sources, seals constitute no exception to the rule in animal life of feeding in season and place upon the things that are the most readily obtained and suitable to their needs'; Fisher and McKenzie (1955), 'the animals have no particular preference for any one kind of food but take what is most readily available'.

The apparent preference for the Salmonidae in river mouths, already referred to, may, therefore, be explained on the grounds that these fish, being present in large numbers and much more obvious in point of size than other members of the fish population, are more readily available to seals.

However, Scottish salmon fishermen will not readily accept this view as most of them are convinced that seals do prefer salmon and sea trout to other fish. Their views, which are based on long observation and experience, appear to be supported by the following records:

1. Captive seals kept in tanks at different times by a salmon fishing firm on the east coast were fed with white fish and occasionally with salmon kelt. It is stated that the seals invariably showed a preference for the latter fish which they ate, leaving only the skin and the head.
2. At 6.45 a.m. on 27th June 1958, a young grey seal was caught and killed in a salmon bagnet near Johnshaven. The heads and other remains of two salmon as well as two live lumpsuckers were also found in the net. While not entirely conclusive this rather indicates a preference for the salmon on the part of the seal.
3. The common seals of the Dornoch Firth during the summer of 1956 were found to be feeding on salmon. This concentration on salmon, despite the presence of a considerable flatfish population at all times, also seems to show a definite preference.
4. Seals on the Ayrshire coast are known to feed predominantly on salmon and sea trout during the spring and summer despite the presence of shoals of various marine fish in the same area. Only during the winter do the seals turn more to flatfishes and cod.
5. When eating salmon, seals almost invariably skin the fish and discard the head and when preying on cod and lythe, which have been meshed in anchored nets, they are known to eat the belly containing the liver and milt or roe. These examples clearly indicate the ability of the seal to distinguish between different parts of the fish and to select particularly desirable portions such as those with a high fat or oil content. It seems reasonable, therefore, to assume that the seal can also select those fish which it knows from experience will provide the kind of food it prefers.
6. The common practice of using sea trout when setting poisoned bait for seals is evidence of the salmon fishermen's views on this matter. If seals were even equally partial to flounders or lumpsuckers, it would clearly be in the fishermen's interests to use these relatively unimportant species rather than sea trout.

In the light of this evidence, therefore, it is not difficult to believe that seals do show a preference for the Salmonidae whenever these fish are present on the grounds.

The food of seals also includes shore fishes of no economic importance. This fact is sometimes used to strengthen the case for the protection of seals. Havinga has shown that on the Dutch coast 25% by weight of the seal's diet may consist of such fish, mostly small forms. Similar forms are undoubtedly eaten by seals on British coasts, but from extensive trawling records within Scottish territorial waters even in water as shallow as 2 or 3 fathoms, it is clear that shore fishes are never present in sufficient quantity to provide anything approaching 25% by weight of the fish population. For example, a number of trawl hauls with a shrimp net cover over the codend in St. Andrews and Carnoustie Bays and in the Dornoch Firth at different times of the year, resulted in a catch of nearly 30,000 fish. Shore fishes of no economic importance formed a very small proportion of this total—from 0 to 10% from haul to haul and with an over-all average of 2%. Within sheltered estuaries and in western sea lochs the numbers of shore fishes may occasionally be rather greater than on other sections of the coast, but although young common seals may feed on these fish more frequently than do the adults, it is still very doubtful if they provide 25% of the common seal's food.

Since the grey seal favours open rocky coasts its food naturally includes species indigenous to such a habitat. Here again, however, fishes of no economic value, such as the wrasses and the lumpsucker are scarce in relation to the numbers of those which are sought by our fishermen. It must be concluded therefore that shore fishes provide only a negligible proportion of the food of common and grey seals in the Scottish area.

The numerous references throughout the literature to the destruction of fish in and around fishing gear is a feature which emphasises the ability of seals to learn and to take advantage of fish meshed or trapped in nets. This covers a wide range in gear types including the halibut and cod greatlines off the Norwegian coast, salmon and cod set-nets in the Baltic, herring drift-nets on the Cornish coast, salmon gill-nets and trolling lures on the Pacific coast of America, ground nets for hake and other varieties in the Minch, lines set for white fish off the coast of Scotland and England (*Fishing News* 1959b; 1960), and salmon bag-nets on the Scottish coast.

Mr. J. G. Jamieson, Inspector of Sea Fisheries, has described an attack by a seal on a shoal of saithe in Stornoway Harbour. The animal pinned the shoal against the quay wall by swimming backwards and forwards in an ever shrinking semi-circle until at last it was able to seize its victim from the mass of panic-stricken fish. Similar evidence has been given by salmon fishermen who have observed seals hunting salmon in the neighbourhood of bag-nets. Quite apart from the robbing of nets and lines therefore, it is obvious that any passive fishing gear acting as a barrier to fish may be put to good use by hunting seals. This is all the more unfortunate where seals gather to prey on concentrations of fish already being exploited by fishermen.

While depredations on gear may sometimes be regarded as no more than a nuisance, not infrequently the damage incurs heavy financial loss to fishermen. In this connection, therefore, it is important to note that, wherever damage has been caused to commercial fisheries by seals, investigators invariably have recommended the continuation of existing measures or the institution of new measures to control the number of seals in the interests of the fishermen. (Hjort and Knipowitsch 1907; Sandman 1912; Matthews 1952 (quoting Steven); Scheffer and Slipp 1944; and others.)

AN EXAMINATION OF SALMON FISHERMEN'S CLAIMS REGARDING DAMAGE BY SEALS

Information on all aspects of the damage to salmon fisheries has been obtained by interviewing netsmen, from replies to a questionnaire addressed to members of their association and from extensive correspondence with fishermen and others in all parts of Scotland. Damage takes different forms and may be classified as follows:

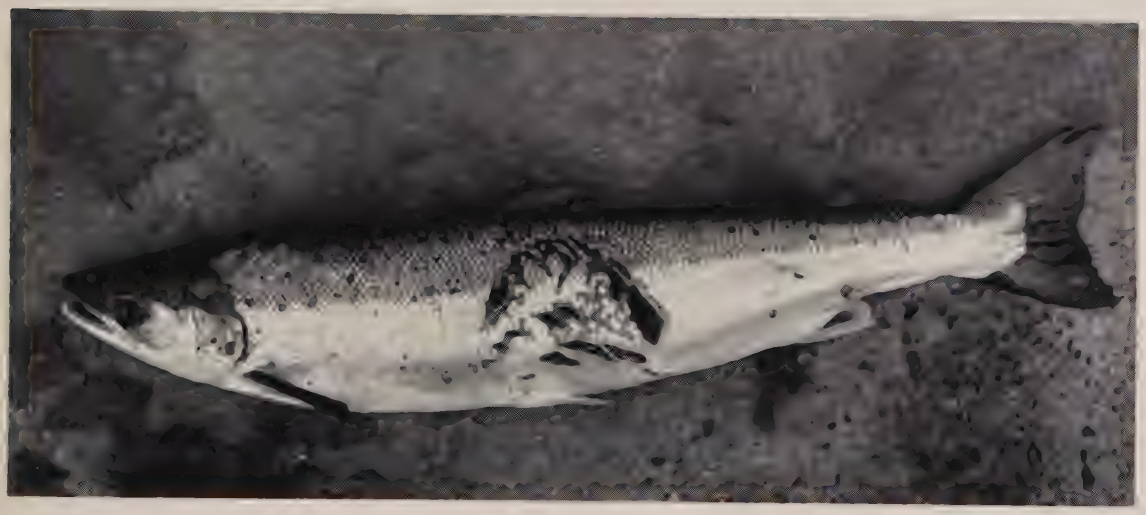

Plate 1 Salmon, showing seal claw-marks, caught near Montrose, February 1960.
Plate 2 Salmon, showing seal claw-marks, caught near Montrose, February 1960.
Plate 3 Salmon, showing seal bite, from mouth of River Dee, Aberdeen, May 195

Plate 4 Salmon, decapitated by seal from outside net, caught in nylon bag-net near Montrose, 21st February 1959.

Plate 5 Salmon, decapitated and partly eaten by seal, near Montrose, 25th February 1959.

Plate 6 Salmon, mutilated by seal, found in bag-net at Balgownie, Aberdeen, May 1959.

Plate 7 Salmon, skinned by seal, taken from bag-net at Montrose, 5th May 1959.

Plate 8 Remains of 30 salmon and one cod, killed and partly eaten by seals, washed ashore near St. Cyrus, Angus, 7th March 1959.

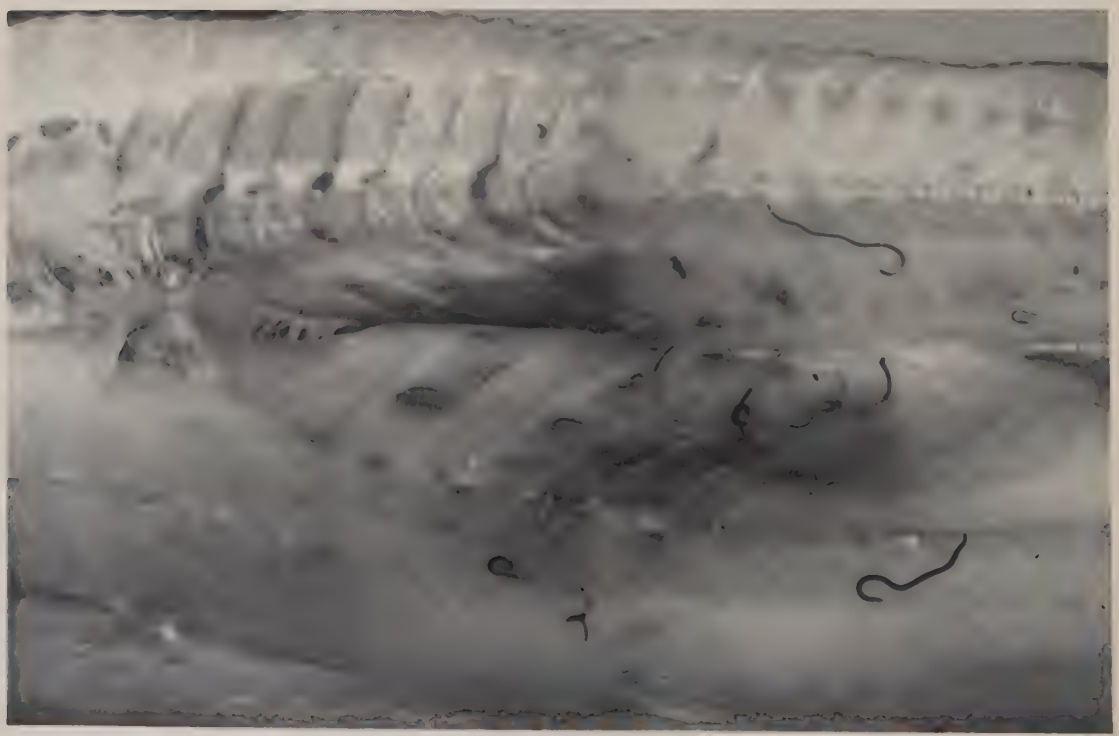

Plate 9 Cod split open to show infestation by larvae of nematode, *Porrocaecum decipiens* Krabbe.

1. Damage to fish—
   (*a*) fish clawed or 'marked' resulting in lowered market value;
   (*b*) fish killed and eaten or partly eaten resulting in total loss.
2. Damage to nets.
3. Interruption and temporary destruction of fishing power.
4. Diversion of fish from the nets.

Damage to Fish

(*a*) *Fish clawed or 'marked' resulting in lowered market value*

'Marked' or damaged salmon are widely encountered on Scottish coasts and in Scottish rivers wherever sweep netting and rod fishing are practised. Estimates of the number of damaged fish vary. In exceptional cases 25% or even 50% may be affected, depending on local circumstances and the time of year. On the other hand 'marked' salmon are not so common on the northern shore of the Solway Firth where seals are less numerous. Salmon fishermen, however, are agreed that, in general, from 5 to 15% of marketable salmon are damaged by seals in one way or another.

During the 1958 and 1959 seasons a study was made of 'marked' salmon exposed for sale on Aberdeen Fish Market. The fish were caught in fixed nets at the entrance to the River Dee and in sweep nets operated within the tidal reaches of the river. Despite the low incidence of seals in the neighbourhood marked fish were surprisingly numerous. On twenty visits to the market from 1st March to 31st May 1958, during which time catches were frequently poor, 40 salmon were observed to be marked. The highest number of wounded fish in one day was 9 out of a total of 117 on 5th March but rather higher proportions were experienced on other dates, for example, 2 out of 20 and 2 out of 8.

On the first day of the 1959 season 20 marked fish were found in a total of 303 from set nets at the entrance to the River Dee. On subsequent dates damaged fish comprised from 5 to 9% of the totals forward for sale. On an average over the two seasons the proportion of damaged fish is estimated at about 5 per cent. This represents a high value for a relatively seal-free area and will be referred to later in this paper.

The marks or wounds on salmon are of different kinds:

(i) Tears or scars, mostly single but sometimes multiple, of varying dimensions from an inch to six inches in length and anything up to an inch or an inch and a half deep, exposing the pink flesh (Plate 1). These occur on almost any part of the fish. Some of the wounds from their open appearance are obviously fresh but others appear to be in the process of healing. From the nature of the wounds and from observation of the manner in which seals use their fore flippers in feeding, these marks are undoubtedly caused by the claws of seals (Plate 2).

(ii) Healed scars, resembling in general appearance those under (i) but completely overgrown by new skin leaving a shallow lightly coloured impression. These are clearly old scars or wounds which have healed.

(iii) Tooth marks, represented by a series of punctures of the skin and underlying tissues. At least one fish exhibiting this multiple type of wound was observed among those examined. In this case the tooth marks were on the top and sides of the head—the inference being that a seal seized the fish in its mouth but let go at least twice in order to get a better hold or to eat the flesh.

(iv) Bites, in some cases shallow, in others deep into the flesh, but in each case exposing the muscle segments and sometimes even the bone. The shape and dimensions of these wounds were found to be consistent with the size of the jaws of seals examined at the Marine Laboratory. Nine of the forty 'marked' salmon examined on Aberdeen Market in 1958 were mutilated in this way. In six cases the wounds were located on the back behind the head, in two in the caudal region and in the remaining fish the flesh had been removed from the pectoral fin almost to the mid-dorsal

region (Plate 3). The remarkable features of these 'bitten' salmon are their success in escapin from their captors and their ability to survive in spite of their injuries.

It is recognised that marked or damaged fish fetch a lower price on the market. This varies accordin to the nature of the wounds but it may range from a few pence, in the case of lightly marked fish, to a much as five shillings per pound less than the equivalent price for perfect, unmarked fish. In this con nection it should be pointed out that even the accidental removal of scales frequently affects the marke value of a luxury food such as salmon.

Records of seal-marked salmon kept by two firms at or near the mouth of the River Tweed in 195 reached the remarkable totals of 810 and 933 fish and the loss was calculated in each case at about £40 Since marked salmon occur on all fishable sections of the Scottish coast and in Scottish rivers the tot number of fish whose value is reduced in this way must be considerable.

(*b*) *Fish killed and eaten or partly eaten resulting in total loss*

In addition to losses in value arising from mutilation of fish in one form or another, salmon fisherme have perhaps to accept even greater losses in the numbers of salmon and sea trout killed and eaten b seals in or near fixed nets. No accurate estimate can of course be made of the extent of this destructio but some indication of the damage done inside nets may be obtained from the frequency with which th heads of salmon, generally with the skin of the fish attached, are found in the nets. This has become frequent occurrence on all Scottish coasts where fixed nets are in use and on several occasions recent the heads of as many as seven salmon have been taken from a single net. Not infrequently the maraudin seal is also found in Scottish nets along with the remains of his prey.

Less frequently, decapitated salmon are found in the nets. Three fish mutilated in this way (Plate 4 were taken from an experimental nylon net near Montrose on 20th February 1959. This reversal of th usual practice by seals could, however, be explained by the fish being gilled and attacked by the se from outside the net. Support for this view is provided by Scheffer (1958, plate 19). Fish damaged this way are, of course, often unmarketable. It is interesting to note that Scheffer and Slipp (1944) reco an American fisherman as having on one occasion found only two marketable fish out of thirteen gill in his salmon net—the others having been destroyed by seals. Other examples of seal damage to salm are illustrated by Plates 5, 6 and 7.

Seals are also known to kill and eat salmon outside the nets. Watchers have observed them waiti for salmon at the junction of the leader and the outer court. This is known as 'leader fishing' and sho that these animals are intelligent enough to learn how to profit by the presence of fishing gear (see p. 2 The extent of the loss to fishermen by this cause cannot be gauged in any way as the heads which a cast up by the tide represent only a small proportion of the fish killed. The following experience however, are relevant and on the whole typical of what is taking place on the Scottish coast.

On 4th May 1958, 30 seals were observed fishing simultaneously off Portgordon in Banffshire. I the short time in which they were under observation it was estimated that each animal killed at lea one fish.

On 7th July 1958, more than 80 mutilated salmon were washed up on the beach between Buckpo and Portgordon. From the appearance of the mangled remains the fish had clearly been killed within very short time in the vicinity of the adjacent bag-nets. This experience, perhaps the result of a stran turn of the tide, may be regarded as rather exceptional but the appearance of heads and other rema of salmon on beaches of the Moray Firth and of other parts of the coast, where nets are set, is a regu feature during the netting season. Furthermore, it is extremely unlikely that the remains of all the f killed in this way are thrown up by the tide.

In July some years ago, fishermen, from the top of a cliff at Macduff, kept a seal under observati for about an hour in which time it was seen to kill 13 salmon of which only parts were eaten. T method employed by the seal was to lie on the bottom amongst seaweed in the shallow water close the mouth of the River Deveron and to strike from below when the fish swam overhead.

From 20th to 25th February 1959, seals were seen killing and eating salmon away from the ne on no fewer than six occasions at one station three miles south of Montrose. Although the configurati

of the beach at this point is not favourable to strandings, salmon remains were washed ashore on three days from the 22nd to the 28th of February.

Further evidence of this destruction was provided on 7th March 1959, when heads and parts of more than 30 fish were washed ashore in the vicinity of bag-nets near St. Cyrus on the coast of Angus. With the exception of one cod all the fish were salmon (Plate 8).

No estimate can be given of the number of fish destroyed by seals but from the evidence of clawed fish and of remains found in nets and thrown up by the tide the toll taken of salmon must be very great.

Damage to Nets

Net damage is experienced in varying degrees on nearly all fishable sections of the Scottish coast. Little or no damage has been reported to sweep nets operated in river mouths and in other sheltered waters but each type of fixed net operated in the sea, fly, jumper and bag, is affected. Bag-nets, which are used mainly on rocky coasts, clearly suffer more severely than the other types. On the whole, damage occurs mainly at two points in the net.

(*a*) to the door into the fish court;

(*b*) near the angle between the small scale and the wall of the fish court.

(*a*) Damage to the door appears to be caused by the seal forcing its way through the narrow entrance, thus dislodging or breaking the pins which keep the side of the door apart. Evidence of this is provided by seals which are found trapped in nets. Occasionally seals, presumably small animals, have been known to enter and leave the fish court by way of the door without damaging the net in any way.

(*b*) Damage to the fish court may be caused in other ways, for example:

1. by the seal entering the net through the door and breaking out by tearing the meshes with its teeth or its fore flippers;

2. by the seal herding a fish into the angle of the scale from outside the net and seizing it through the netting thus tearing the meshes.

Each of these methods of approach by the seal has been witnessed by observers on cliffs overlooking bag-nets.

Records of nets torn by seals have been kept by salmon fishing firms at different points on the coast. In the area immediately to the north and south of the River Tweed, where damage has been severe for several years, records have been examined by Dr. Lockie of the Nature Conservancy (1959). Similar records from other localities are being studied by Mr. W. M. Shearer, of the Freshwater Fisheries Laboratory, Pitlochry, to whom the author is indebted for much information on net damage and other matters. For the present it is sufficient to refer to a few typical cases. At a fishing station station south of Montrose, where four standard nets and one experimental nylon net were in operation, the four normal nets were damaged on seven occasions during the four days 17th-20th February 1959, and on six occasions from 24th-27th February. Although the nylon net was not torn it nevertheless was entered or otherwise interfered with by seals every day during the two weeks and not one marketable fish was taken from it. A good catch of 35 salmon was obtained from the four standard nets on 17th February when none of the nets was torn. On the 18th, when three nets were damaged, the catch dropped to 18 fish. On the 19th and 20th and from 24th to 27th February, when from one to three nets were damaged every day, the total daily catch consisted of only 2 or 3 fish most of which were mutilated and unfit for the market. Throughout the two weeks seals were very numerous around the nets.

At another station near the mouth of the River North Esk, where four nets were in operation, nets were damaged five times during the week ending 21st February and twelve times during the week ending 28th February. The total daily catch for the station, although promising at first, fell away and during the last three days of each week not a single fish was caught. Some of these nets were torn every day.

Although it is recognised that the numbers of salmon at any point on the coast may vary from

time to time, thus affecting the catch from day to day, there appears to be some correlation between the numbers of seals, the increase in the number of torn nets and the declining catches. The data also appear to bear out the fishermen's contention that seal damage is greatest when salmon are scarce.

Similar records have been obtained from other parts of the coast and the overall picture in the last few years is one of increasing damage from seals. This is particularly serious on the southern shore of the Moray Firth. On the Caithness Coast a netsman has reported 'severe damage to nets'. Another, operating on the east side of Dunnet Bay, now postpones commencement of fishing until June as an earlier start in recent years has invariably resulted in torn nets every day. Much damage is also caused on the north-west coast during the opening months of the season. A netsman on the Ayrshire coast, who has been experimenting with nylon nets, reports less damage to nets but doubts if this results in any improvement in the catch.

These records show that net damage is greatest in localities where seals are most numerous and that it diminishes with a decline in the number of these animals. Slight damage is still experienced in areas where seals are relatively scarce, such as the coast immediately to the north and south of Aberdeen and it is only in the Solway Firth that salmon fishermen are almost free from this trouble. There is no doubt that this problem has increased concurrently with the growth of the grey seal stocks in recent years. Although formerly confined to the spring months, this form of damage is now experienced throughout the year. Fortunately, in some localities, it declines with the approach of summer so that netsmen who are prevented from sharing in the fishery from the start of the season are enabled to benefit in some degree.

Interruption and Temporary Destruction of Fishing Power

Although the repair of damaged nets must entail a growing expense to netsmen every year, especially having regard to the increasing costs of labour and materials, this is probably of secondary importance to the losses incurred through the interruption and temporary reduction of fishing power and the consequent escape of fish through holes torn by the seals. It should be emphasised that, unless some indication of a seal's visit to a net is provided by the presence of salmon heads, etc., a hole made by the animal making its escape may remain undetected for days until the net is finally taken ashore.

The experience of a crew at the Bay of Nigg, near Aberdeen, on 11th February 1959, illustrates the nature of the losses from torn nets. On this occasion the fishermen surprised a seal just as it had entered the net by the door. Before it could be killed the animal broke out through the netting to liberty, followed immediately by most of the catch of 20 to 30 salmon.

Diversion of Fish from the Nets

Yet another complaint by netsmen concerns the diversion of salmon from nets by seals lying in wait near the leader. This aspect of seal behaviour and the reactions of fish to it has been observed by watchers on high ground overlooking a series of nets. Such behaviour is in keeping with an earlier conclusion regarding the ability of seals to profit by the positioning of fixed nets. Furthermore, many salmon fishermen are convinced that the visit of a seal to a net renders that net less effective as a fishing unit for several days afterwards. Canadian research (Alderdice, Brett, Idler and Fagerlund, 1954) has shown that Pacific salmon are able to detect odours associated with predator animals such as the hair-seal and sea-lion and that the movements of the fish may be influenced by the introduction of an extract from the skin of these animals to the water in their path. There is therefore some scientific evidence to support the view of Scottish salmon fishermen.

Damage to fish and to nets has been experienced at certain stations near seal colonies for many years but in the last ten years this has increased on most sections of the coast and has spread to localities hitherto almost immune from attack by seals. There is evidence, too, that the extent of the damage inflicted on salmon fisheries by seals is greater than the numbers of clawed or dead fish and the incidence of torn nets indicate. In this connection further consideration may be given to the proportions of clawed and mutilated fish in different localities. As already stated this varies from one station to another, but in places where seals are comparatively scarce, for example at Aberdeen and in certain rivers, the

percentage of damaged fish is still appreciable. Even in the Solway, where seals are rare at the present time, clawed fish are found in the catches. This overall prevalence of damaged fish is surprising but an explanation seems to lie in the movements and behaviour of the salmon and of the seals. Menzies (1949) and Went (1955) have postulated that salmon, coming in from the Atlantic, strike the west coasts of Scotland and Eire at certain points from which they then move northwards or southwards in search of their native rivers. Each of these writers has shown by tagging and subsequent recaptures in bag-nets that many, if indeed not all, salmon undertake coastal movements and that some may even cover hundreds of miles in doing so. Pyefinch and Woodward (1955), Pyefinch and Shearer (1957) and Shearer (1958) have demonstrated similar movements and behaviour in salmon on the Scottish east coast. Since it has already been shown that the Scottish coasts are now almost completely surrounded by a ring of seals, it follows that coastwise-moving salmon must run the gauntlet of continuous attack until they reach their destination in the rivers. This would appear to account for the high proportion of marked fish on some seal-free coasts and also the rather puzzling feature of healed scars resulting from injuries to the fish sustained perhaps some weeks or even months previous to their capture.

Discussion of other Possible Causes of Damage to Salmon and Nets

Attempts have been made to put the blame for the damage to salmon fisheries on other animals such as otters, porpoises, sharks and other fish. Otters take toll of salmon in rivers and possibly also in the sea but attempts are made to control the numbers of these animals and the damage they do can represent only a very small fraction of the total. Despite evidence suggesting that porpoises prey on salmon (Berry 1934-1935) there are no records of salmon or sea trout having been found in their stomachs. Although their teeth are unlike those of most marine fish eaters, porpoises are regarded as preying mainly on small fish such as herring and whiting and this has been confirmed by the examination of the stomach contents of a number of porpoises caught in Scottish coastal waters. Porpoises are rarely taken in salmon nets but quite frequently in cod-nets. According to cod-net fishermen cod are always intact when caught along with a porpoise, whereas fish are invariably mutilated when taken with a seal or in a net which has been visited by a seal. The nature of the damage to the cod is similar to that inflicted on salmon and there is no evidence that this is caused by porpoises.

The porbeagle shark is known on occasion to eat salmon on offshore grounds. This species, however, is not common in Scottish waters, and only in November and December of certain years does it come within territorial limits, and even then only in small numbers. No trace of salmon has been found in any porbeagles from coastal grounds nor indeed are the wounds on salmon in any way in keeping with attack by sharks. Ground sharks such as the Greenland and six-gilled sharks no doubt also eat salmon but these species are now rare in Scottish waters.

From experience of the food of the larger gadoids these fish cannot be regarded as serious predators on salmon. The head of a salmon was recently found in the stomach of a large ling but it is by no means certain that the ling killed the salmon. Indeed, from the position of capture of the ling, on the coast of Lewis, it is not improbable that the salmon was killed by a seal and the discarded head subsequently swallowed by the ling; alternatively the head may have been thrown overboard from a ship. The infrequency with which fish heads alone appear in the stomachs of other fish tends to support this view.

There is, therefore, little evidence in support of statements that the destruction of salmon and salmon nets is caused by animals other than seals. On the other hand evidence of seals observed killing, skinning and eating salmon, and of their interference with salmon nets, is so overwhelming as to leave no doubt of the cause of the harm done to salmon fisheries.

THE EFFECT OF SEAL STOCKS ON MARINE FISHERIES

Damage to Fish and Fishing Gear

Literature dealing with seals contains numerous references to their interference with marine fisheries on European and American coasts. Some of the older naturalists (Harvie-Brown and Buckley

1887; Harvie-Brown 1891) mention the stripping of fish from hooks off the Scottish coast, but at no time in the past has this assumed any great proportions and no complaints have been made to fishery authorities. However, reports by the Inspectors of Scottish Sea Fisheries in 1958 show that marine fishermen are becoming increasingly aware of the growing numbers of seals, particularly in certain areas where seine-net fishing is permitted by bye-law within territorial waters. Fishermen who pursue active fishing methods, such as trawling and seining, are less likely to suffer damage to gear or to their fish by seals than are those who depend on passive methods such as drift nets, anchored nets and lines. Fortunately most drift netting takes place well offshore, away from the main seal concentrations, but fixed nets and lines within territorial waters have been suffering in recent years from interference by seals. Ground-nets in the North Minch and cod-nets on the coast of Angus are particularly affected. In each locality fishing gear is being damaged and some of the fish caught are sometimes so mutilated as to be unmarketable. In both areas a common form of damage to the fish consists of the removal of the belly region containing the liver and roe or milt.

Fishermen in the Minch have suffered from the activities of seals for many years but to cod-net fishermen in Angus this threat is relatively recent. In the last five years the number of damaged cod has increased and during the winters of 1958-59 and 1959-60 has been estimated at 10% of the total catch. Damage to nets is also becoming more frequent and several grey seals have been drowned in cod-nets, including some animals tagged on the Farne Islands.

In the same localities seals are also known to be removing fish from hooks on lines. One grey seal, subsequently examined at the Marine Laboratory, for example, had stripped the fish, codling, haddock and whiting, from each hook up to that on which it was itself caught and drowned. Similar experiences have been reported by fishermen lining for hake in the Minch and from recent press reports it would appear that line fishermen on the coast of England suffer in the same way (*Fishing News* 1959b; 1960).

Although fishing by line and by fixed nets now provide only a small proportion of the total yield by British sea fisheries these methods are nevertheless, owing to circumstance, an essential means of livelihood to fishermen and their families in certain districts. Furthermore, such fishing methods are selective in action and therefore worthy of encouragement at the present time when intensity of fishing renders conservation of stocks of prime importance.

Damage to Fish Stocks

Serious though these losses are to individual fishermen, locally, they represent but a small proportion of the damage inflicted on marine fish stocks generally by the seal population of the British Isles. Although fishermen in coastal waters frequently observe seals feeding on fish escaping from their nets, it is perhaps not surprising that they have little conception of the real nature of the destruction wrought, as few people are aware of the overall numbers of these animals now preying on our fish stocks. This aspect of the subject, however, cannot be disregarded by fishery administrators or scientists who are concerned with the protection of fish stocks.

Some indication of the drain on fish stocks round the British Isles may be obtained by adopting the method of calculation, already employed locally by Matthews (1952), by Vik (1959) and by others, on the basis of Lockley's estimate of 20,000 grey seals and Steven's estimated average daily consumption of 15 lb of fish by each animal. This means that the grey seal population eats on an average 134 tons of fish daily and 48,884 tons every year. To this must be added the fish eaten by an unknown number of common seals. Assuming that this species numbers 18,000 and accepting its daily diet, calculated by Havinga (1933), as 11 lb, the common seal population must account for 88 tons of fish per day and 32,263 tons yearly. Together, the two species therefore consume over 220 tons of fish daily and over 80,000 tons yearly. This represents nearly one-fifth of the total annual British catch of all kinds of fish from home waters. It has already been estimated that about 80% of the seal population is based on Scottish coasts; assuming that the quantity of fish eaten is in the same proportion this means that 65,000 tons of all kinds of fish are eaten by seals in Scottish waters every year. This is nearly one fourth of the total Scottish catch from home waters. It is not suggested that this quantity of fish would instead be caught by fishermen if the seals were not there, but it does mean that less is available in the sea for

he fishermen and that it is all the harder for them to get a profitable catch. At the same time it should e recognised that more fish may be killed by seals than are actually eaten by them so that one can only guess at the total harm done to fish life by these animals.

This, then, represents another drain on fish stocks already severely taxed to maintain commercial isheries. It is true that larger quantities of fish are probably consumed by fish themselves but sooner r later the resultant fish flesh is available to fishermen in one form or another so that there is no loss. Apart from some limited exploitation of the common seal, the seal stocks of the British Isles are virtually unexploited and therefore uneconomic and fish eaten by these animals may be regarded almost as a complete loss.

During the 1930s the problem of overfishing became acute in the North Sea and on other fishing grounds round the British Isles. Following scientific investigations, measures were introduced on a national basis to counter the dangers of overfishing and after the Second Great War these were extended by international agreement to apply to all countries of north-western Europe. In spite of these efforts he stocks of marine fish in many areas are still subjected to strain by heavy exploitation. When this condition coincides with poor recruitment to stocks from natural causes a dangerous situation is liable o develop. Furthermore, fishing within British territorial waters has been either prohibited or only permitted locally on specified conditions for nearly one hundred years for various social and scientific reasons.

In all these circumstances, therefore, it seems undesirable to maintain large numbers of any animal known to prey on the stocks of economically important fish and even less desirable to contemplate any increase in its numbers. The original purpose of the Grey Seals Protection Act 1914, to prevent the extinction of the species, has long ago been rendered invalid by the increase in the number of grey seals o at least forty times their strength in 1914 (assuming the original estimate of 500 to be correct). For various reasons, therefore, the protection of grey seals is no longer necessary.

The Propagation of the Cod Worm by Seals

Yet another harmful effect of seals on fish stocks remains to be considered. This is their share in he incidence of the larval stages of the parasitic nematode, *Porrocaecum decipiens* Krabbe, in the flesh of od and other marine fish (Plate 9). Canadian scientists (Scott and Martin 1957) have demonstrated he life cycle of this parasite in cod and in seals, including both the common and the grey species. The ame worm has been found in the stomachs of most of the seals of both species examined at Aberdeen luring the past two years; only the very young pups appeared to be free from infestation. It has also been observed that the degree of infestation in grey seals is invariably greater than in common seals, a eature which has already been noted by Scott and Fisher (1958).

Infestation of cod by the young stages of this worm is a major problem of the fishing industry in ome coastal regions of eastern Canada. Wormy cod are also known from certain grounds fished by British vessels at Iceland and on the western side of the British Isles, where cod and saithe are often nmarketable for this reason. North Sea cod have until recently been regarded as free from this parasite xcept for an occasional fish taken close to the rocks in certain localities. However, during the past two ears worm-infested cod have been sent to the Marine Laboratory by fish merchants on several occasions. hese fish were caught on grounds off the Scottish east coast and enquiries addressed to fish merchants ave shown that this infection of the cod has been slowly but gradually developing since 1950.

This problem has been studied at first hand on a number of cruises by Scottish research vessels over ne last two years. Although investigations are still being pursued the results already show a remarkably rge number of cod and codling parasitised by larvae of *Porrocaecum decipiens* on grounds hitherto garded as free from worm infection. Infestation is almost confined to fish of marketable size and is ariable geographically (Figure 1). In the North Sea, eastwards of 1°W longitude, the numbers of ffected cod are negligible but to the westwards of this line the position is different. Within this coastal elt infestation varies considerably, from almost complete freedom from parasites off the Aberdeenshire oast to over 20% in the area stretching from the Berwickshire coast to the Farne Deeps and in coastal aters of Orkney and Shetland. Intermediate degrees of infestation occur east of May Island, within ne Firth of Forth and in the Moray Firth. Off the west coast of Scotland nearly 40% of the cod are

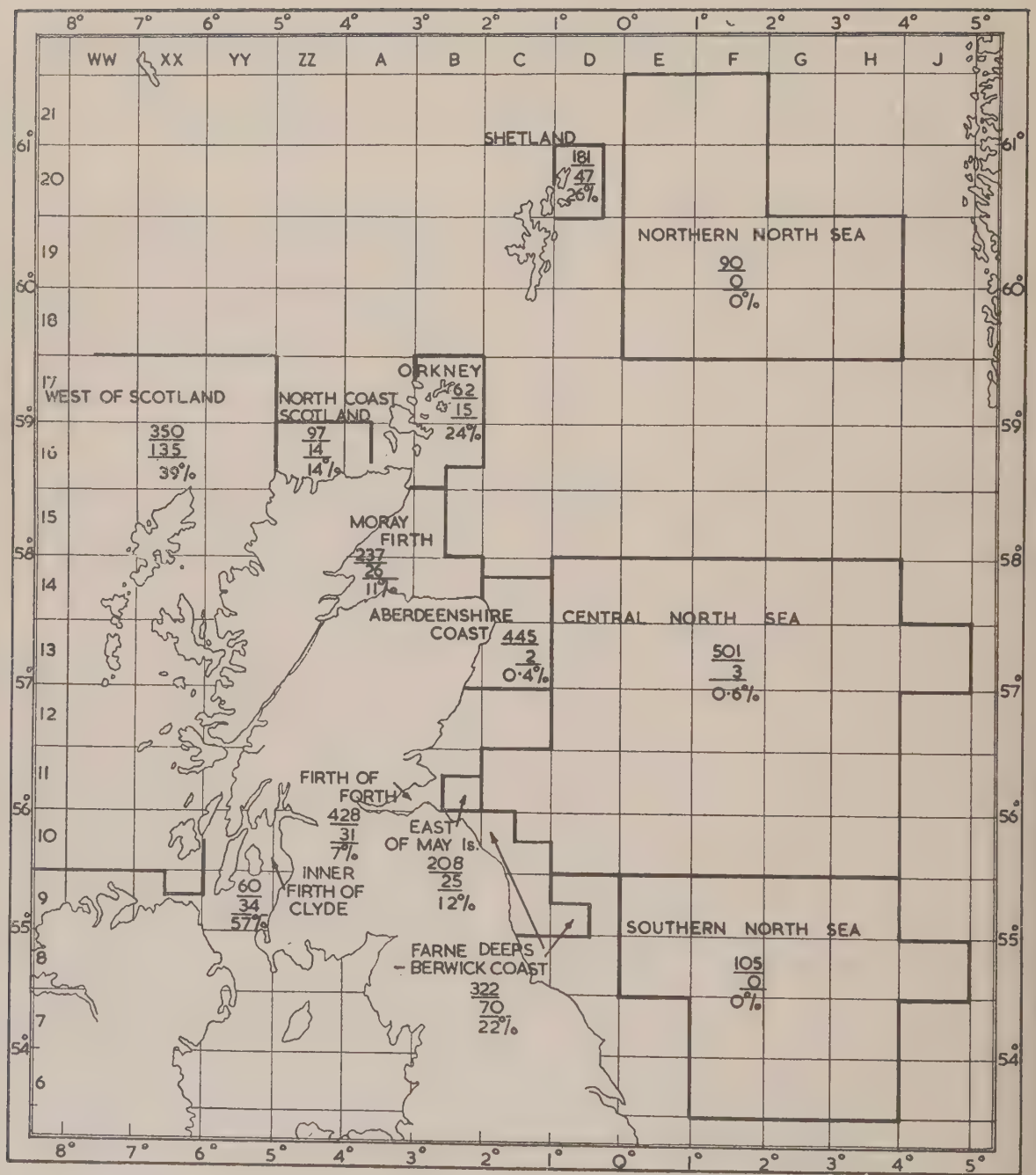

Figure 1 Infestation of cod flesh by larvae of *Porrocaecum decipiens*, Scottish waters, 1958-59. Number of cod examined (top); number of cod parasitised (middle); percentage (bottom).

fected and in the upper Firth of Clyde over 50%. These percentages of infested fish show a close cor-lation with the numbers of seals in the various areas and in this respect the results are in agreement ith those of the Canadians, Scott and Martin (1957).

It is fortunate that, despite the wide and increasing incidence of the infestation, so far in general remains low within individual fish, but this form of parasitism is accumulative and if seals are permitted increase or even to continue at their present level infestation of cod will certainly increase. Cod rovides nearly half of the total British white fish catch from all fishing grounds and about a quarter of e North Sea total. It requires little imagination, therefore, to realise the gravity of the threat which creasing worm-infestation carries to the fish trade generally and to the market for prime North Sea od in particular.

GENERAL DISCUSSION AND CONSIDERATION OF THE CASE FOR SEALS

Throughout the long history of the seal-salmon controversy one thing stands out clearly. This is e consistent nature of the claims made by the salmon fishermen. From the 1920s, when their case was rst stated, to the present year their complaints have been concerned with damage to fish and to fishing ear. The only difference over the years is that instead of coming from individual netsmen in particular calities the complaints are now made in respect of all salmon fishermen on all coasts. From a study of e nature of their claims it is concluded that seals are undoubtedly causing significant damage to the hery. Furthermore the problem as it affects sea fisheries shows some features of which the fishing dustry and the country as a whole are as yet not fully aware—namely the magnitude of the annual ll taken of fish stocks by seals round our shores and the highly undesirable development of the parasite festation of white fish, particularly cod.

It is also essential to examine the arguments put forward by those who wish to maintain seal stocks their present high level or even to allow them to increase. Nobody will question the wisdom of the iginal purpose of the Grey Seals Protection Act 1914—to prevent the extinction of the species. istorical research on the subject has thrown doubt on the validity of the view that the grey seal was the point of extinction, but assuming that protection was essential in 1914, it would seem obvious om the latest estimate of the grey seal population that further protection is no longer necessary. If, by y chance, this is not so, then at least it is incumbent on those claiming continued protection to provide e evidence for this claim and this has not been done. Nevertheless, misinformed statements 'that stocks e declining', and 'in danger of extinction' are still used (Hansard 1958; Grey and Hickling 1958; nith 1958) despite authoritative statements by experts to the contrary.

Opposition to the claims of salmon fishermen is frequently based on the complaint that no connection n be demonstrated between the numbers of seals and the salmon catch. The annual catch of salmon Scotland has certainly shown no sign of diminishing in recent years (Scottish Home Department 1959) t the average yearly catch for the period 1951 to 1957, 1,488 tons, compares unfavourably with the rresponding amount for the years 1931 to 1937, of 1,976 tons. Fishery biologists, however, see no ason why such a connection should exist or be easily demonstrable if it does. The salmon catch is pendent on several widely divergent factors: for example, the number of spawning fish several years eviously, the weather at the time of spawning and throughout the larval and post-larval life of the , the survival of the various broods from the egg to the smolt stage, the fortunes of these broods on ir feeding grounds in the sea and the conditions which finally determine when the fish return to wn. Major trends in abundance are known which may be environmentally determined. At present, attempt to estimate the total stocks of salmon in the sea or even the stocks about to enter coastal ters can be little better than guesswork. Consequently, the catch is unpredictable and may be good poor irrespective of the numbers of seals on the coast. Furthermore, local and seasonal variations in run of salmon not infrequently give a false impression of the distribution and abundance of the while only recently have more reliable estimates of catches become available. Whatever the effect eals on the total stocks may be, the significant and demonstrable feature is their effect on the catches.

It is clear that salmon, in the penultimate stage of their spawning migration, often hug the coast f considerable distances and thus are subjected to almost continual attack by the ring of seals round t Scottish coast. It would appear, too, that seals are aided in their predation by the nature of the passi fishing gear used to catch salmon (pp. 20, 22, 24). Finally, it must be concluded that the activities seals have been seriously affecting salmon fisheries on the coast of Scotland for some time and in m cases have reduced the margin of profit derived from them.

It is claimed that this has necessitated reorganisation within individual firms, involving a reducti in the number of active stations and in the number of fishermen employed. Salmon fishing, for examp has been completely discontinued on the coast of Fife, on long stretches of the Caithness Coast and points on the Ayrshire Coast in recent years. Various factors may have accounted for the decisions these cases but it is undeniable that ravages by seals were contributory and it is entirely due to t activities of these animals that netsmen at Burnmouth in Berwickshire, at Portgordon in Banffshire, a at Lossiemouth in Morayshire, are at the present time seriously considering giving up their fishings.

Other arguments used by those advocating further protection of seals include:

1. seals do not eat fish—their food is mainly crustaceans and molluscs;

2. seals eat mostly fish of no economic importance;

3. seals eat mainly fish of little economic importance;

4. seals do no harm to fisheries.

The section on the food and feeding habits of seals has already shown how inaccurate these vie are. The statements reported in Hansard (1929) that grey seals live on barnacles and that it had not b proved that they eat fish are without foundation. Although certain species of Arctic seals feed larg on invertebrates the grey and common seals are predominantly fish eaters after the initial weeks of th lives. Attempts have been made to prove that the grey seal feeds mainly on lumpsuckers, regardless the relative scarcity of this fish on British coasts. Reference has already been made to the compara scarcity of 'non-economic' species generally in the fish population of Scottish coastal waters and to small part they play in the food of seals. The third argument that seals feed mainly on fish of little econo importance cannot be accepted by fishery scientists. Not only has it been demonstrated that both spe feed almost entirely on salmon and sea trout under certain conditions and at certain seasons but ne every commercial sea fish is included in their diet. This list includes halibut, the highest priced of all fish, other prime flat-fishes and almost every type of round fish down to the lowest priced varie However cheap some of these fish, such as lythe, saithe and conger, may be, each brings a return fishermen. Moreover, when prime fish are scarce fishermen frequently depend on bulk catches of cheaper varieties. Thus, trawlermen fishing off Shetland are pleased with a hold full of saithe, grou netters in the Minch with a catch of lythe or dogfish and drifters or ring netters on the west coast w mackerel, in the absence of more desirable species. Lastly it should be pointed out that many cro fishermen in Shetland and Orkney, in the Western Isles and on the West of Scotland depend on sh of saithe, lythe and conger in their local waters for daily food and winter stores.

Statements that seals can do no harm to fisheries can only be regarded as irresponsible. The pre review has shown that seal stocks now maintain a constant threat to salmon and marine fisheries or Scottish coasts. Scarcity of fish has been experienced at different times both locally and on a wider s These shortages may have been due to natural fluctuations or to heavy fishing effort or to a combina of the two. In some places, notably in the Hebrides and in parts of the mainland of Scotland, ill fishing in territorial waters has also been blamed. It is obvious, however, that the effect on fish st of large numbers of predators such as seals must also be considerable and cannot be ignored. Then every reason to believe that fish stocks, whether already affected by fishing or not, may be appreci depleted by large numbers of seals.

It is also illogical to permit the existence of large numbers of fish predators while at the same t measures are being taken to improve fish stocks. In this connection it is appropriate to mention efforts being made by private individuals and by various public bodies:

(*a*) to enable salmon to overcome natural obstacles, the effects of hydro-electric and other water schemes and river pollution;

(*b*) to stock new waters and improve existing stocks by artificial propagation and transplantation of fry;

(*c*) to control river predators;

(*d*) to regulate sea and river fisheries for salmon;

all of which tend to be nullified in some degree by failure to control one major sea predator, the seal. Similarly, national and international regulations to conserve stocks of marine fish are also to some extent rendered less effective by the same omission.

Claims are also made that seals improve stocks of fish by killing the weak and diseased individuals. Havinga (1933) categorically denies this claim by stating that the flat-fish found in the stomachs of seals on the Dutch coast were healthy specimens. Moreover, no evidence has been found in the literature of any beneficial effect exercised by seals on fish stocks. Indeed, from the commercial viewpoint the incidence of worm parasites in cod is just the reverse.

Yet another claim is made that seals justify their existence by feeding on predators of young salmon. It is commonly thought that the larger gadoids feed on salmon smolts during their transition from fresh to salt water, but there are no published results to support this view and the stomach contents of several hundred cod caught near the mouth of the River Dee at Aberdeen during the smolt run have shown no trace of young salmonids. It has been stated that seals, by killing lumpsuckers and conger eels, help to maintain lobster stocks on which these fish are said to prey. While this may be true, some fishermen and scientists believe that seals also prey on lobsters so that the two claims would appear to cancel each other out. Gordon (1950) refers to the good work of seals in reducing dogfish shoals, which at one time were the scourge of herring fishermen, but the dogfish is now a species of some importance as human food so that the seal may now be regarded as the pest even in this respect. Darling (1947) also attempts to justify seals by pointing out that they eat big fish which prey on smaller fish but this argument, too, is inadmissible for reasons given earlier in this paper (p. 27).

The exclusion of the common seal from the protective Acts was no doubt due to the fact that at the beginning of the century this species was more numerous than the grey and also because of its habit of frequenting sheltered waters, where it was more easily recognised and where the destruction it caused was more readily appreciated. The inability of many people to distinguish between the two species has also led to confusion and to an unfortunate tendency to put the blame for seal depredations on the common seal. At the present time, when the grey seal now appears to outnumber its smaller relative, this unfortunate practice continues and attempts are still made to accuse the common seal of depredations committed by the grey.

A final claim by supporters of seal preservation remains to be mentioned. This is the statement or more frequently the insinuation that salmon fishermen, and the Government Departments concerned, wish to have seals exterminated. This is very far from the truth. Despite the losses suffered by salmon fishermen in recent years the writer during innumerable interviews and discussions has never heard any fishermen express any such wish. Indeed, many fishermen and netsmen are competent naturalists with perhaps as sound a knowledge of seals and their habits as many of the individuals who write to the press in defence of these animals. This interest is exemplified by the readiness and goodwill with which the majority of netsmen have continued through mounting difficulties to return seal tags with the requisite information to the appropriate authorities. Salmon fishermen have no desire to see the grey seal or the common seal exterminated but they do insist that the numbers of both seals should be kept within reasonable limits in order to avoid excessive damage to fisheries. As Sir John Craster (1959) has pointed out, a thousand grey seals on the Farne Islands would give as much pleasure to visitors and to naturalists as the present population of 3,200. The present research policy of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne of allowing the population on these islands to increase just to see what will happen, with its attendant overcrowding, its high pup mortality and its growing incidence of disease represents a form of cruelty which must seem abhorrent to most animal lovers.

The closure of salmon fishings in recent years has already resulted in a reduction in the numbe of men employed in Scotland. At present, rather less than 2,000 are employed at this fishery, but ther are unmistakable signs that, unless an immediate and effective reduction is made in the numbers o seals, further closures of fishings may follow, at least among the smaller firms. The livelihood of workin men and their families (to say nothing of the nation's white fish supplies) would seem to demand prio consideration to the demands of a few for the continuation and expansion of uneconomic seal stocks.

SUMMARY

A brief historical account is given of events from the passing of the Grey Seals Protection Act 191 to the present time. Attention is drawn to the unsatisfactory evidence on which the first Act was base to the subsequent increase in the grey seal stocks and to the growth of complaints from salmon fishermer

The numbers and distribution of the common and grey seal are studied from published scientif papers and from recent reports and correspondence. The grey seal is shown to have increased in numbe on all British coasts with the possible exception of Cornwall and the Scilly Isles and to be extending i breeding places. The common seal, more local in its distribution than the grey, causes damage in som localities but the absence of protection makes this species more easily controlled by the usual method

The food of common and grey seals is studied from published accounts and from the examinatio of the stomach contents of seals killed on the Scottish coast from 1958 to 1960. After a short period which the young of both species feed on shrimps, crabs and molluscs, both seals feed almost exclusive on fish. Nearly every well-known species among British food-fishes is eaten but there is evidence th seals often show a preference for salmon and sea trout.

Claims by fishermen of destruction to salmon fisheries are examined. Damage is undoubtedly bei experienced on a considerable and increasing scale to fish, to nets, to fishing power and by the probal diversion of fish from nets.

The effect of seals on marine fisheries is also studied. Whilst some damage is being caused to f and to gear in certain localities, the main damage appears to lie in the overall quantity of marine f eaten by the large seal stocks. This amounts to the equivalent of nearly one-fifth of the total catch of commercial species from home waters. At least 80% of British seals are concentrated in Scottish wat and naturally the depletion of commercial fish stocks is also higher in the same region.

The harmful effect on fish, particularly cod, by the spread of a larval, parasitic worm is also d cussed. Attention is drawn to the increase in the numbers of parasitised cod in recent years on the Scott east coast and to the striking correlation between areas where infestation of cod is highest and th where seals are most numerous.

The case for the conservation of seals is reviewed. Arguments for the maintenance of seal stocks a criticised in the light of efforts being made to improve salmon stocks and of conservation measures n in force in regard to heavily exploited marine fish stocks. It is concluded that seal stocks must be reduc and thereafter maintained at a level which will not interfere unduly with commercial fisheries.

APPENDIX

The Grey Seals Protection Acts and Events Leading up to Them

The first Grey Seals Protection Act was passed in 1914. Inspiration for this Act was provided in the first place by a prominent sportsman and hunter, H. Hesketh Prichard, in an article published in the *Cornhill Magazine* (Prichard 1913 and 1921, footnote page 19, and Parker 1924, page 115). The author drew attention to the Hebridean custom of slaughtering young and old grey seals on the island of Haskeir during the breeding season by the primitive though effective method of clubbing and stated that as a result of these killings the grey seal was 'slowly but surely advancing along the road to extinction'. The latter statement was taken up by the editor of the *Cornhill Magazine* who induced a Member of Parliament to promote a Bill. It is interesting to note that Prichard's observations were made despite certain facts. In the first place the author never witnessed the killing of seals which he so vividly described, his information having been obtained entirely from local people. The numbers of seals killed yearly on Haskeir at the time of Prichard's visits to the Western Isles ranged from 30 to 40 and the total for all the islands from 39 to 47, but were never so great as the numbers, 200 to 300, killed in the same area some 200 years earlier (Martin 1703). The author was aware that skins and oil were used for domestic purposes by the local people but appeared to be influenced by his personal view that on occasion more seals were killed than were immediately required. He also knew that, because of the habits of the grey seal and of the inaccessibility of Haskeir and other breeding grounds during the season, opportunities for such killings were comparatively rare and indeed did not occur every year. Prichard's concern for the survival of the grey seal is remarkably at variance with his own numerous killings of the animal for the purpose of supplying Mr. J. G. Millais with material for a study of the skins or of satisfying his own sporting instincts. Furthermore, his quotation from Martin (1703), showing that clubbing of seals was practised regularly on Haskeir more than 200 years previously, seems to reduce the danger of extinction which he feared.

Prichard's article has been considered in some detail since it set a standard in emotional appeal, in scientific inaccuracy and in illogical reasoning which appears to have been followed, doubtless under misapprehension, in subsequent press articles and statements on the grey seal (Hansard, November 1929, p. 1341, and July 1958, p. 1094; Gray 1935; Hickling 1958; Smith 1958; Buxton 1958; Lillie 1959).

The promoters of the bill, in claiming that the grey seal was in danger of becoming extinct, alleged that the numbers around Scotland were as low as 500. Some years later Dr. (afterwards Professor) James Ritchie and Mr. W. L. Calderwood, while undertaking a survey of grey seal stocks, found no evidence to show how this figure was determined (see also Hansard 1929) and a re-examination of the available documents by the present writer has again failed to provide an explanation. It is clear that the figure of 500 was not based on any scientific investigation and may have been the result of a simple count at different places. Indeed, there is a strong probability that the total was an under-estimation. This view finds support from subsequent discoveries that seals seen on various parts of the British coast were in fact grey seals and not common seals, as they had long been thought to be (Steven 1936; Salmon 1935; Matthews 1940; Duncan 1952; Davies 1949; Eggeling 1957) and also from our present knowledge of seal behaviour and from modern methods of population estimation.

No objections to the Bill were raised by the Ministry of Agriculture and Fisheries or by the Fishery Board for Scotland. There is moreover no evidence that the possible effect of the Act on salmon fisheries was examined by any Government Department. Certainly no thought was given to its effect on marine fish for the danger of stock depletion in the sea had not yet been clearly envisaged. Nor is there any indication that its effect on the economy of the Western Isles was considered in any way. No attempt appears to have been made to check the allegation that seals were killed in excess of the numbers required for the immediate needs of the natives or to discover the islanders' purpose in doing so if it were true.

Much has been said and written in the last 30 years about the decline in the local fisheries of th Western Isles. Invariably the blame has been put on modern fishing methods. Although these method have undoubtedly played a major part in this decline, one must wonder just how much is due to th increase in the number of seals since 1914. As will be seen later the grey seal in some parts of the we of Scotland feeds on rougher species of fish such as ling, saithe, lythe and conger eels, but these ar precisely the species which have always been most highly esteemed by the people of the Islands and s some parts of the mainland.

It is unfortunate that, despite its admirable purpose, this Act should have been based on suc unsatisfactory evidence. Its rapid and successful passage through both Houses would appear to hav been due to the energy of its promoter, Mr. Charles Lyell, who had the Bill in draft form almost co currently with the publication of Prichard's article in July 1913, and possibly to the general apathy the members at that time, as the following extract from a letter, dated 25th April 1914, from Mr. Lyc to Hesketh Prichard shows:

'So far all's well. We scratched our quorum out of all sorts of holes and corners, and there was qui a brisk little cheer when the twentieth man walked in! There was about five minutes' jaw, and then went through without amendment. I am going to try for the further stages tomorrow, but I think w really are all right now'. (Parker 1924, p. 116).

Whatever the grey seal population was in 1914 it is clear that the numbers had increased by th early 1920s when complaints were heard for the first time from salmon fishermen concerning the growi numbers of seals. Prichard's (1921, p. 107) surprising statement, that in 99 cases out of a 100 it is the comm seal that eats salmon and damages nets, may therefore indicate a certain apprehension that reason opposition might be made against his case. At this time reports appeared in the press indicating that illeg killings had been resumed on the west of Scotland. Prichard (1921, p. 19) refers to this in the followi sentence: 'This (Grey Seals Protection Act 1914) has, however, now lapsed, as it only provided for years protection and the clubbing has begun again. Will not some M.P. take the matter up agai Neither of his statements, however, was correct since the Act was at that time being extended fr year to year under the Expiring Laws Continuance Acts and investigations by the Police and by t Fishery Board for Scotland found no evidence of any disregard of the Law.

About this time an owner of salmon fishings on the north coast of Scotland had experiences wh in later years were given prominence in Parliament. This netsman (Magniac 1929) after taking ove fishing in 1923, found that the previous owner had given it up because of seal damage. So great was destruction of fish and gear that in the first year only two salmon were caught. An intensive shooting the seals was started in 1923 and by the end of 1924 about 300 seals had been accounted for. Operati were continued up to the end of 1927 by which time a total of 624 seals, mostly grey seals, had be killed. The numbers of salmon and grilse taken during the period were as follows:

Year	*1923*	*1924*	*1925*	*1926*	*1927*
Salmon	2	16	87	181	129
Grilse	–	–	817	896	638
	2	16	904	1077	767

Allowing for fluctuations in the annual run of these fish, it is clear that the killing of a large num of seals resulted in much improved catches.

In 1927, following the preparation of a memorandum by the Chairman of the Fishery Board Scotland on seal damage to salmon fisheries, Professor J. Ritchie and Mr. W. L. Calderwood w asked by the Secretary of State to investigate the grey seal population of the Scottish coast. In their rep (1928) they estimated (*a*) the number to be between 4,000 and 5,000; (*b*) that a thousand young cal were born every year and (*c*) that the danger of extermination, which had been the chief reason the passing of the 1914 Act, no longer existed. The report also pointed out that, although the grey s is vulnerable during the breeding season when it hauls out on certain islands, the remote situation of

reeding grounds and the difficulty of access in any but calm weather afford a certain amount of natural rotection.

In spite of these conclusions the second Grey Seals Protection Act was passed in 1932. This Act iffered from that of 1914 in being permanent and in extending the original close season, 1st October o 15th December, to run from 1st September to 31st December. Because it also granted powers to the ecretary of State for Scotland and to the Minister of Agriculture and Fisheries to cancel the close time y making an order, either generally or in respect of a particular area, if it should be thought necessary, pposition to the Bill from individual M.P.s during its earlier stages was withdrawn.

Complaints continued to reach the Scottish Office, for example from Ayrshire and Wigtownshire here increased numbers of seals had been reported, but on the whole the netsmen appear to have ecided to study the operation of the Act in the years which followed. At the same time the occasional ooting of seals, both grey and common, continued. About this time marine fishermen on the Cornish nd Welsh coasts were also suffering from the ravages of grey seals on fish stocks and on nets. This ulminated in an operation by the local Fishery Board against the seals on the Cornish coast in which 77 were shot.

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